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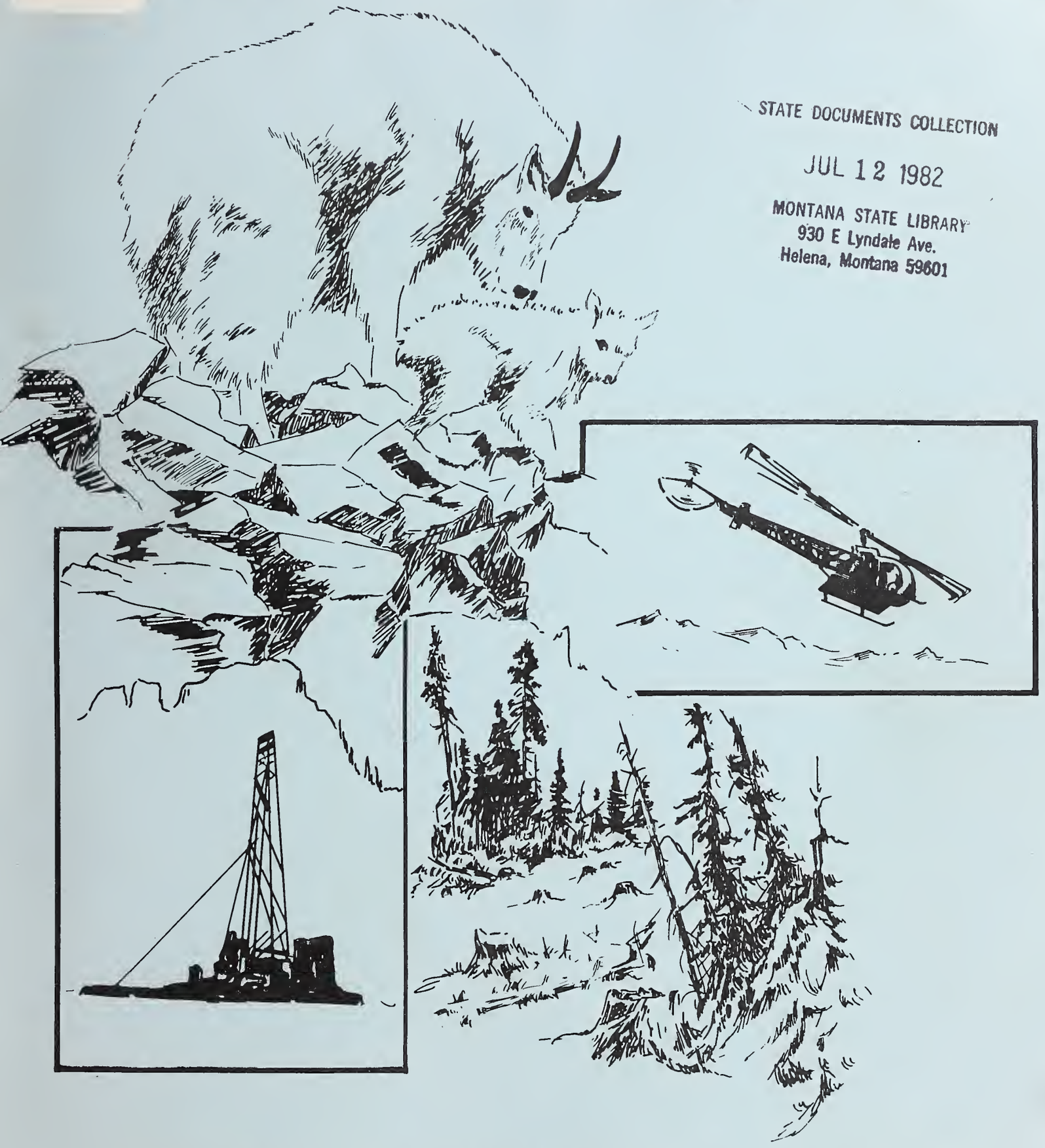

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MOUNTAIN GOAT HABITAT MANAGEMENT PLAN FOR THE CABINET MOUNTAINS, MONTANA

Prepared by

Gayle Joslin
Montana Department of Fish, Wildlife and Parks
Ecological Services Division

In Cooperation With

Kootenai National Forest

1980

FEB 3 1988

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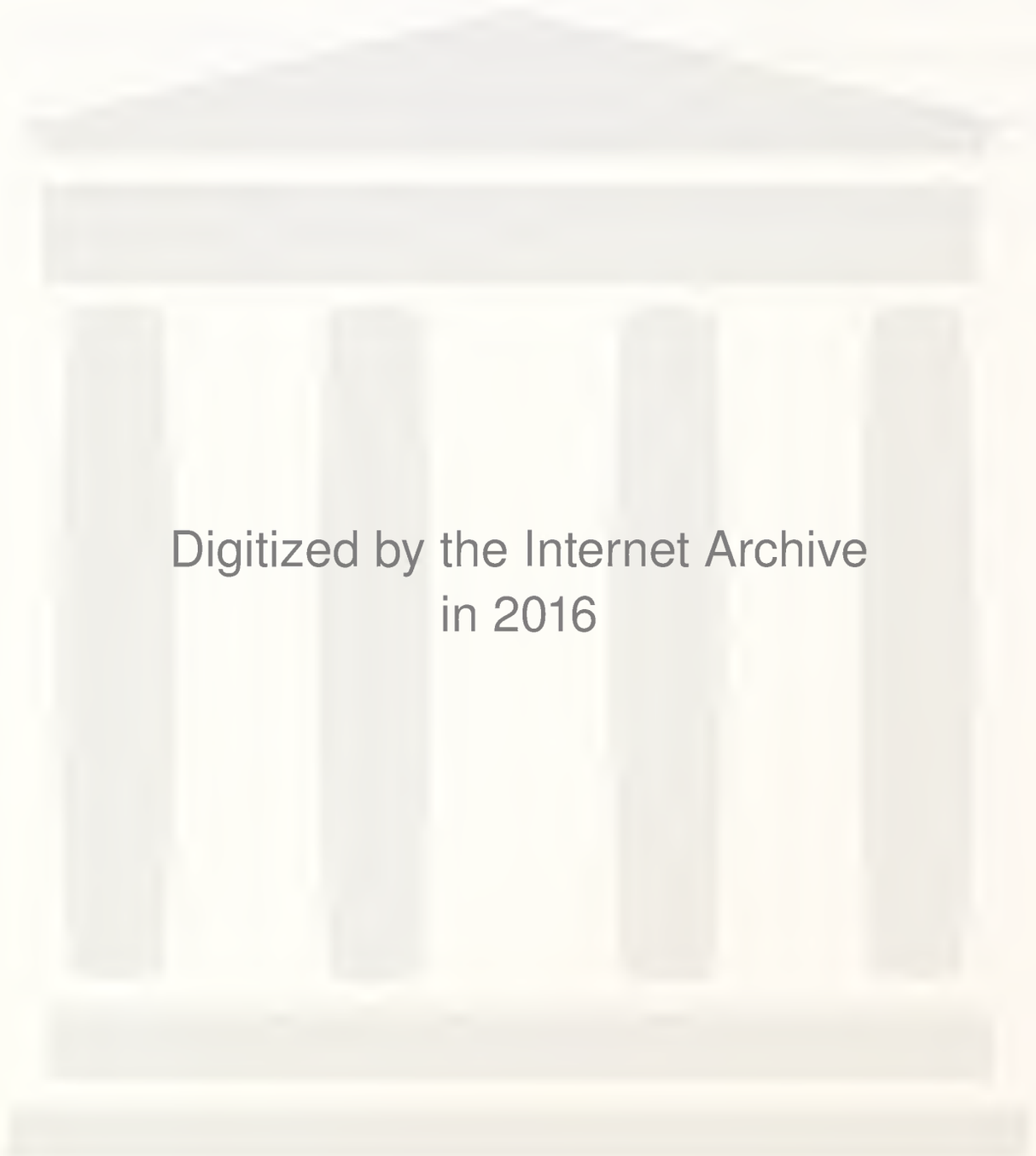
2. Mountain goat seasonal range and overall habitat in the Cabinet Mountains.

3. Roads, mining claims, cutting units and timber sales in relation to overall mountain goat habitat and seasonal ranges.

4. Fire occurrence in relation to mountain goat habitat and seasonal ranges.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EXECUTIVE SUMMARY

Many mountain goat populations across North America are suffering declines largely as a result of man-related activities. This mountain goat habitat management plan was developed for the Cabinet Mountains because this area affords an excellent opportunity to study mountain goats and the relationship between the species and the numerous land management activities occurring there. The goal of this work was to provide recommendations to land managers to help avoid or minimize the effects of land management activities including logging, mining and recreation, upon mountain goats and their habitat.

The Cabinet Mountains contain over 350,000 acres of mountain goat habitat and are inhabited by a native population of between 95 and 160 individuals.

Methods used to develop this plan included aerial and ground reconnaissance, laboratory analysis, personal interviews, file searches and literature review. The study was initiated during June 1979 and field research was completed by July 1980 although limited information had been collected from April 1977 through July 1978.

A review of mountain goat literature was completed to develop an understanding of the unique ecology of this species. Information reviewed included physical characteristics, reproduction, mortality, food habits, social structure and behavior. An understanding of the physiological and behavioral attributes as well as the limitations of mountain goats is essential before their response or adaptability to habitat alterations can be predicted.

Mountain Goat Ecology

Unlike deer, elk or moose, but similar to bighorn sheep, mountain goats have evolved with limited behavioral capabilities. This limited but specialized behavior has helped them to efficiently exploit the niche of rigorous terrain which they occupy. Highly traditional behavior restricts mountain goats to regular seasonal use patterns, which in turn make them vulnerable to human activities or habitat changes within their range. Compared to other North American ungulates, mountain goats have a high natural mortality rate. Human induced mortality appears to be additive rather than compensatory and can therefore be devastating to a population if proper management is not implemented and carefully monitored.

Habitat Use

If the nature of the Cabinet Mountains habitat can be generalized, it would be described as having a predictable summer climate and high quality subalpine summer range, while winter climate is severe and winter range limited and precipitous.

Mountain goat terrain in the East Cabinets ranges from about 3,800 feet to 8,700 feet while in the West Cabinets the elevation spread is from 2,800 to 6,900 feet. Seasonal elevational movements indicate that goats are generally at low elevations in spring, move up in late spring and summer and move down again in fall and winter.

Mountain goats select use sites based on elevation, aspect and topography which provide seasonal comfort, security and food requirements.

During winter and spring goats were observed in the timber cover type most often while the grass/forb cover type was important in the spring and summer and the rock/bare ground type received greatest use during fall and winter. When green grass and forbs are available they receive the greatest use by goats. When desiccation or snow renders grasses and forbs undesirable or unavailable, shrubs and trees assume greater importance.

Mountain goat summer range generally occurs in the *Abies lasiocarpa* series while most winter ranges occur within the *Pseudotsuga menziesii* series. Interspersion of various cover types over an area is likely more important to mountain goats than the ultimate climax habitat type since a number of habitat types may have essentially equal cover and forage characteristics at some time during their development.

Cliff and bluff terrain types provided the most secure escape terrain and were the most important of the eight described types during all seasons except summer when the use of terrain types were not primarily tied to security.

Observed use of aspect indicated that nearly all spring observations were noted on east and south aspects; north aspects were used predominantly during summer; west and south aspects received the majority of fall use; and similar to spring, east and south aspects received the majority of winter use.

Goats were generally observed less than 30 feet from escape terrain and they were rarely observed closer than 1 mile from the nearest drivable road.

Food Habits

Food habits analysis from collected pellet groups indicated that shrubs dominated the diet during all months. Grasses and grass-like plants were second in importance during the majority of sample periods. At least some use of tree foliage was noted. It is possible that the histological technique employed underestimated the use of forbs and lichens in the diet due to the highly digestible nature of these plants.

As with most ungulate species, mountain goats exploit winter ranges which allow minimum energy expenditure in obtaining maintenance forage.

Seasonal Ranges

The East Cabinet Mountains are linear in habitat configuration and have three major goat concentration areas, each having its own winter and summer range. The West Cabinet Mountains have a more circular configuration with winter ranges occurring around the periphery and summer range in the center. It was not determined to what degree discrete herds exist in the Cabinet Mountains or whether intermingling between concentration areas is the norm.

Winter range extends down to about 3,000 feet and generally exhibited slopes of about 80 percent on defined use areas. Minimum snow depth indexes on the 65 identified winter range sites ranged from 0 to 88 inches. Three categories of winter ranges including confirmed, probable and possible were mapped. In the East Cabinets five sites totaling 3,002 acres were identified as confirmed winter use areas while in the West Cabinets 11 confirmed winter use areas were identified totaling 3,837 acres. Twenty-two (9,119 acres) and 11 (6,596 acres) sites in the East and West Cabinets respectively were identified as probable winter areas based on observations during spring and/or fall, goat tracks, suitable environmental conditions and proximity to other seasonal range. Ten and six sites totaling 3,488 and 1,761 acres in the East and West Cabinets, respectively, were delineated as possible winter use sites. All areas identified as possible winter range are known to have supported goats during other seasons, and during mild years these areas may continue to be used into the winter.

Summer-transitional range refers to summer use areas and migration routes to and from winter range. Summer and transitional ranges in the Cabinets were delineated from the lowest to the highest points on the study area although with certain exceptions summer range generally occurred at or above 5,000 feet.

Although winter range appears to be the limiting factor to mountain goat densities in the Cabinet Mountains, quality summer range is also of paramount importance in providing high quality forage which sustains the population from year to year.

Importance of ridges as travel corridors is discussed.

The Spires area of Mount Vernon in the West Cabinets was documented as an important kidding grounds.

Factors Influencing Mountain Goats and Their Habitat

Motorized access in or near mountain goat habitat is probably the single biggest threat to goat herds throughout North America. Approximately 4,700 miles of roads have been constructed on the Kootenai National Forest with another 5,000 miles potentially identified to be built. Roads into Drift, Cheer and Cliff creeks contributed to legal and illegal over-harvesting of goats. Other drainages within the study area which experienced similar

problems are discussed. Topography and vegetation can both be used to screen goat habitat from view when roads parallel goat cliffs, but restrictive road management is a more effective tool in protecting goat habitat. Road closures will be a positive first step toward herd reestablishment in some drainages. Specific recommendations regarding placement and closure of roads are provided. Barriers to goat movements should be avoided including fences, snow berms and pipelines or they should be constructed to allow wildlife to cross.

Mining is the most significant potential industrial threat to mountain goats in the Cabinet Mountains today because the 1872 mining law proves for little control of activities and no consideration for wildlife. Location information on over 2,000 mining claims within the Cabinet Mountains study area was mapped. In the Cabinets there are at least 45 drainages in which mining claims occur within or near mountain goat habitat. Areas of current major exploration or development activity occur in three areas (Mount Vernon, Ross Point and Rock Peak) which are very important mountain goat habitat. Literature has shown that associated human activities throughout an area surrounding a new mine will typically cause more significant impacts than the mine itself. Use of helicopters should be encouraged to accomplish exploration activities but constraints should be imposed to avoid impacts upon goats. Busing of workers to and from the mine site should be initiated. Busing has proven in other areas to significantly reduce road kills and poaching. Drill rig engines should be muffled. Where mining is occurring in a particular area other man-related activities should not occur.

Vegetative manipulation through logging operations in the Cabinet Mountains do not appear to have directly affected mountain goats. Although mountain goat habitat in the Cabinets is generally not suitable for timber removal because of fragile soils, oversteepened slopes and short growing seasons, some cuts in the forest abut or encroach into such areas. Three fundamental ramifications may occur from logging including disturbance from the operation, decreased security and habitat alteration. Two different circumstances occurred in the Cabinets where the timing and placement of logging sales and the associated roads influenced the security of local mountain goat herds. In both instances vegetation which could have screened goat range from view was removed from the road right-of-way. Logging operations, as well as pre and post activities should not occur during critical periods or in sensitive goat use areas; they should be timed to occur during the period of least goat use and unit size and shape should be small and irregular and should avoid ridges. Specific recommendations are given.

The current livestock grazing system is probably having little or no effect upon mountain goats on the study area. It is recommended that grazing not be increased in the Cabinet Mountains.

Recreation in the form of viewing, photography and hunting often lead to a better understanding and appreciation of wildlife, but when recreation becomes too intensive it may damage the wildlife resource. Attention should not be drawn to areas where goats are easily observed - to avoid inadvertently increasing conflicts between man and goats. Non-mechanized recreation, although increasing, does not yet appear to be influencing mountain goats in the Cabinets. Options in trail management exist if foot and horse travel appear to be affecting normal mountain goat use patterns or behavior. Uncontrolled snowmobiling can be a significant threat to mountain goats during stressful winter and spring periods. A road closure violation report-reward system could be expanded to control snowmobile travel violations. Suggested alterations in the 1980 Forest Travel Plan are provided to help reduce recreational impacts to mountain goats. Unless all mountain goat herds are equally difficult to reach hunting pressure is not distributed evenly. Since 1954 over 300 mountain goats have been legally harvested in Hunting District 100 with an estimated high of 56 in 1957 to 0 in 1968. It is apparent that over the years the demand for hunting recreation not only exceeded the ability of the resource to sustain the pressure, but that our knowledge of the population dynamics of mountain goats was developing too slowly to enact the needed restrictions to prevent the population from declining. In areas where hunting is too concentrated a variety of road management options are available to help correct the problem.

Seven mountain goats from the Olympic National Park in Washington were transplanted to the Drift Creek drainage of the West Cabinet Mountains during July 1980. One animal died shortly thereafter but monitoring of three radio-equipped animals is continuing. It is important to preserve existing mountain goat populations rather than allow them to become decimated and then attempt reintroductions, because although we can physically transplant mountain goats we cannot transplant thousands of years of home range knowledge. In areas where reintroductions are justified animals must be free of disease and parasites which are exotic to the new area. Transplant stock should come from ranges similar to those in which they will be released.

The relationship of fire to mountain goat range is not well understood. The known occurrence and extent of fires in the Cabinet Mountains was mapped. A severe fire on mountain goat winter range might mean the demise of a wintering herd since goats traditionally use the same areas year after year and in some areas timber is known to be critically important in reducing snow depths. Yet, fire may provide the all purpose method of reducing slash, recycling soil nutrients and stimulating growth of certain forage species. Long-range planning and monitoring of selected sites would be a prerequisite to any habitat improvement program. Before burning takes place the forage species targeted for manipulation must be identified, its ecology understood and the desired management goals outlined.

Management of Mountain Goat Range

Recommendations for management of mountain goats and goat habitat in the Cabinet Mountains have been divided into three parts. First, the area has been delineated (Map 2) according to seasonal ranges and the sensitivity of each to habitat manipulation or human activity. Second, recommendations are given regarding specific activities and other factors capable of influencing mountain goats and their habitat. Third, the need for a long-term commitment to management is discussed in terms of continued monitoring of the species and human activities in the area. The high suitability of the mountain goat as a management indicator species is discussed.

Management Situation 1 constitutes critical mountain goat summer and/or winter range. Use of these areas was documented with numerous observations. Management Situation 2 constitutes areas of summer and/or winter range but in which few observations of mountain goats were recorded. Management Situation 2 areas may have had historic populations of goats but are not currently known to support them although the site appears to have all the features of suitable habitat. Management Situation 3 areas are not known to be important summer/transitional or winter range but because of their juxtaposition to Management Situation 1 and Management Situation 2 areas it would not be unusual to observe goats in these areas.

Specific recommendations for management of activities in each combination of Management Situation and seasonal ranges are given.

Management Indicator Species - Future Monitoring Needs

Mountain goats fit all designated criteria in qualifying as a management indicator species. Monitoring mountain goat herds in the Cabinets is vital to determining the changes in mountain goat ecology as a result of human activities or developments and then reducing or eliminating those impacts. Such information will allow more precise management rather than sweeping protective measures over a large area.

CHAPTER 1

INTRODUCTION

Until recently mountain goats were considered immune from human developments since "their rugged habitat was unsuitable for man's purposes" (Foss and Rognrud 1971). Across North America, however, mountain goat populations have experienced recent declines which can largely be attributed to human activities. The first significant herd declines were documented in Idaho in the 1950's (Brandborg 1955) as a result of road access for mining, but it was not until the mid-1970's that reductions in other areas were recognized. Increasing road access (Phelps et al. 1975, British Columbia), logging (Chadwick 1973, Montana), mining (Pendergast and Bindernagle 1977, British Columbia), hunting (Kuck 1977, Idaho) and fire suppression (Johnson 1977a, Washington) have all been blamed for the declines. It has become apparent that the effects of civilization are indeed being felt by the mountain goat.

The Cabinet Mountains in northwest Montana contain over 350,000 acres of mountain goat habitat and a native population of between 95 and 160 goats. Demands on natural resources of this area which is administered by the Kootenai National Forest are among the highest in Montana; so the actual and potential conflicts with mountain goats and goat habitat may be more critical here than elsewhere in the Northern Region of the Forest Service. The Kootenai harvests more timber than any other national forest in Montana and is also receiving a great deal of attention from the mining industry in their exploration and development of the area's minerals. Both logging and mining bring road construction, ancillary developments and recreationists. For these reasons the Cabinet Mountains, with its native mountain goat population, was a prime area to develop a habitat management plan.

The objectives of this study were to obtain information on mountain goat distribution, population structure and dynamics, habitat requirements and the influence of human activities upon each of these. This habitat management plan provides recommendations to the forest service to help minimize or avoid detrimental effects upon mountain goats and their habitat when activities in mountain goat range are unavoidable.

In Montana 95 percent of the mountain goat habitat occurs on national forest lands. The future of this species is contingent upon land management policies implemented on these lands. Current forest planning is being directed by the National Forest Management Act which provides explicit direction to "maintain viable populations of all existing native vertebrate species in the planning area and to maintain and improve habitat of management indicator species" (219. 12-g). The seven requirements provided in the regulations to meet this goal are:

1. The desired future condition of fish and wildlife, will be stated in terms both of animal population trends and of amount and quality of habitat;

2. Management indicator species will be identified for planning;

3. Biologists from state fish and wildlife agencies and other federal agencies will be consulted in order to coordinate planning with state plans for fish and wildlife;

4. Access and dispersal problems of hunting, fishing and other visitor uses will be considered;

5. The effects of pest and fire management on fish and wildlife populations will be considered;

6. Population trends of the management indicator species will be monitored and relationships to habitat changes determined;

7. Critical habitat for threatened and endangered species will be determined.

The first six of these requirements are pertinent to mountain goats and are addressed in this report.

This study was conducted by the Montana Department of Fish, Wildlife and Parks with partial funding from the Kootenai National Forest. Work was initiated during June 1979 and field research was completed by July 1980, although limited information had been collected from April 1977 through July 1978.

CHAPTER 2

DESCRIPTION OF CABINET MOUNTAINS STUDY AREA

Over 500,000 acres of land in the Cabinet Mountains were inventoried for their suitability as mountain goat habitat. Approximately 367,565 acres were delineated as suitable habitat and are outlined in Map 1. This area is referred to throughout this report as the study area. The Cabinet Mountains occur in Lincoln and Sanders counties of northwest Montana and in Boundary County of northeast Idaho. Rising south of the Kootenai River the Cabinet Mountains trend south-southeast to the Clark Fork River. The East Cabinet Mountains are separated from the West Cabinets by the Lake Creek-Bull River Valley. The valley is divided by a gentle glacial moraine between the headwaters of the Bull River which flow south to the Clark Fork and the headwaters of Lake Creek which flow north to the Kootenai River. The West Cabinet Mountains extend west into Idaho, thus approximately 38 percent of the West Cabinet study area occurs in Idaho.

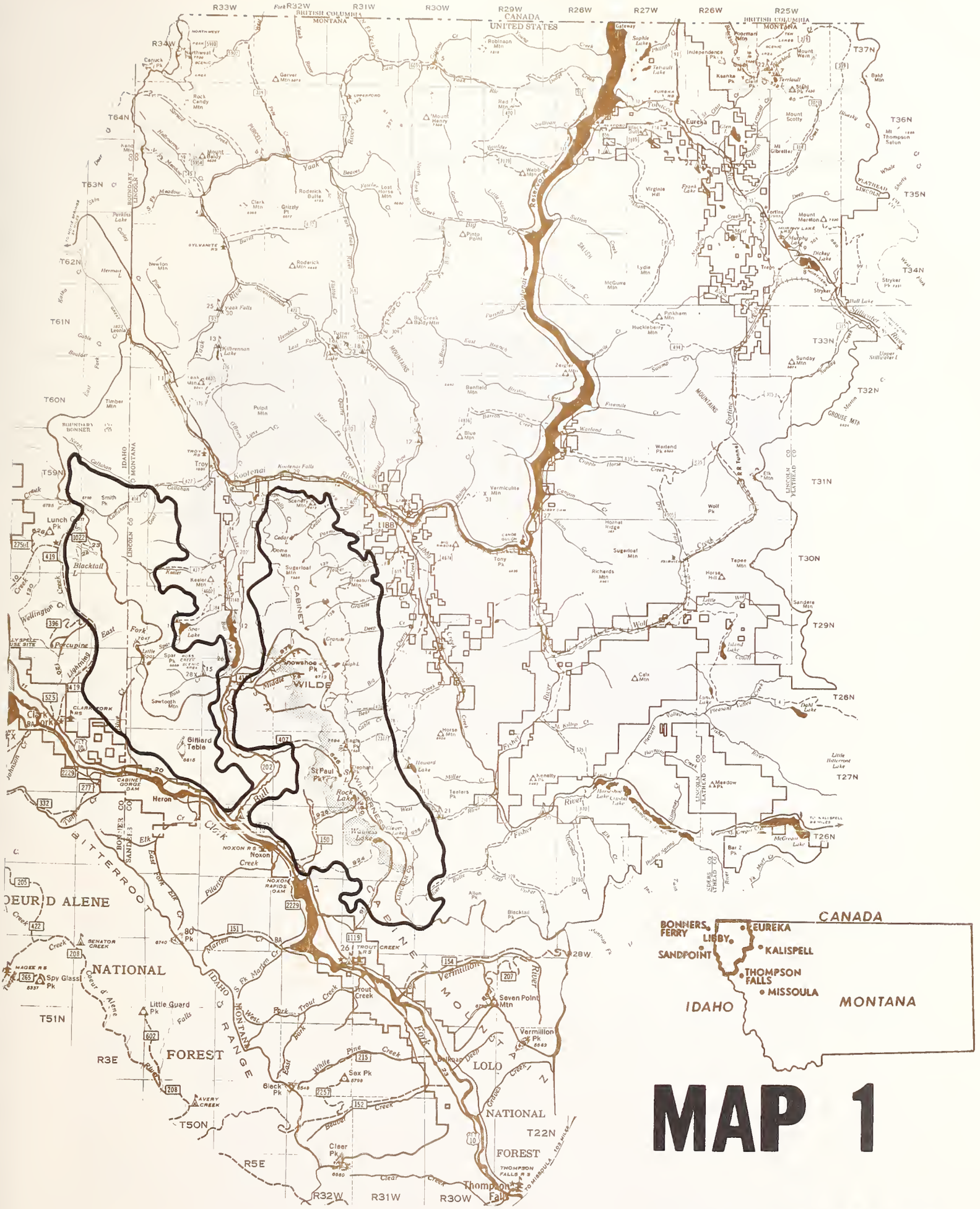
Thirty-two percent of the West Cabinet study area occurs on the Panhandle National Forest. The Cabinet, Troy, Libby and Canoe Gulch Ranger Districts on the Kootenai National Forest and the Sandpoint Ranger District on the Panhandle National Forest administer approximately 129,900; 98,500; 73,400; 17,000; and 48,700 acres of the study area, respectively. Approximately 98 percent of the land area is under federal jurisdiction while the Montana Department of Fish, Wildlife and Parks and the Idaho Department of Fish and Game are responsible for wildlife management in their respective states. The majority of the remaining 2 percent is owned by small private interests, the St. Regis Paper Company, Burlington Northern, the State of Montana, Pack River and Champion International.

The Cabinets are a rugged range of mountains which rise from about 2,000 feet mean sea level to 8,738 feet atop Snowshoe Peak. The climate is characterized by short warm summers, heavy wet snowfalls during winter, high humidity and moderate winds. Precipitation levels range from 30 inches along the valleys to over 110 inches on some ridges, with up to 80 percent falling as snow and resulting in snowpacks of 14 feet and greater at the upper elevations. Average monthly temperatures at Heron (at the southern boundary of the study area) and Troy (at the northern boundary) reach lows of 24 F and 22 F, respectively, in January and highs of 63 F and 64 F, respectively, in July (National Oceanic and Atmospheric Administration 1963-1980).

Of the eight habitat type series occurring on the Kootenai National Forest only the *Abies lasiocarpa* and *Pseudotsuga menziesii* series are particularly important within mountain goat range, but these series form the bulk of the coniferous forest in Montana (Pfister et al. 1977). The *Abies lasiocarpa* (ABLA - subalpine fir) series includes all forests potentially dominated at climax by *Abies lasiocarpa*, *Tsuga mertensiana*, *Pinus albicaulis*, or *Laris lyallii*. It is bordered at upper elevations

by alpine tundra, thus this series forms timberline at its upper reaches. In northwestern Montana it is bordered below by either moist cool forests in the *Abies grandis, Thuja plicata* or *Tsuga heterophylla* series or on drier slopes by the *Pseudotsuga menziesii* series. The *Abies lasiocarpa* series is divided into three elevational categories including lower subalpine habitat types, upper subalpine habitat types and timberline habitat types. Six habitat types in the lower subalpine category were noted on the study area. The ABLA/CLUN (*Clintonia uniflora* - queencup beadlily) habitat type is a common type occurring in the lower, warmer portion of the series. The ABLA/LIBO (*Linnaea borealis* - twinflower) habitat type was not as widely distributed as the ABLA/CLUN type and it was located on cooler aspects. The ABLA/MEFE (*Menziesia ferruginea* - menziesia) type is probably the most widely distributed habitat type within this series at elevations generally above the CLUN type. The TSME/MEFE (*Tsuga mertensiana* - mountain hemlock) habitat type is distinguished from the ABLA/MEFE type by the presence of successfully reproducing TSME. This localized habitat type was noted on ridge tops around the south fork of Ross Creek and on Mount Vernon. The ABLA/XETE (*Xerophyllum tenax* - beargrass) habitat type on drier sites than the MEFE types, it often occurs along ridges and extends downward on south slopes. The TSME/XETE habitat type, defined by the presence of successfully reproducing TSME, also occurs along ridge tops and was noted within the South Fork of Ross Creek drainage. Two upper subalpine habitat types were noted on the study area including ABLA/LUHI (*Luzula hitchcockii* - smooth wood rush) and TSME/LUHI, which are distinguished by the absence or presence of successfully reproducing TSME. These habitat types were the most common upper elevation habitat types in the West Cabinet Mountains. They generally occurred on high ridges and plateaus, the TSME/LUHI type occurs in more localized moist spots. The timberline habitat types were noted on the study area and occurred primarily in the East Cabinets where elevations were up to 1,800 feet above the highest points in the West Cabinets. The PIAL/ABLA (*Pinus albicaulis* - whitebark pine) habitat type is the most extensive timberline habitat type on the study area while the LALY/ABLA (*Larix lyallii* - mountain larch) habitat type is more localized and apparently confined to granitic soils (Arno 1970).

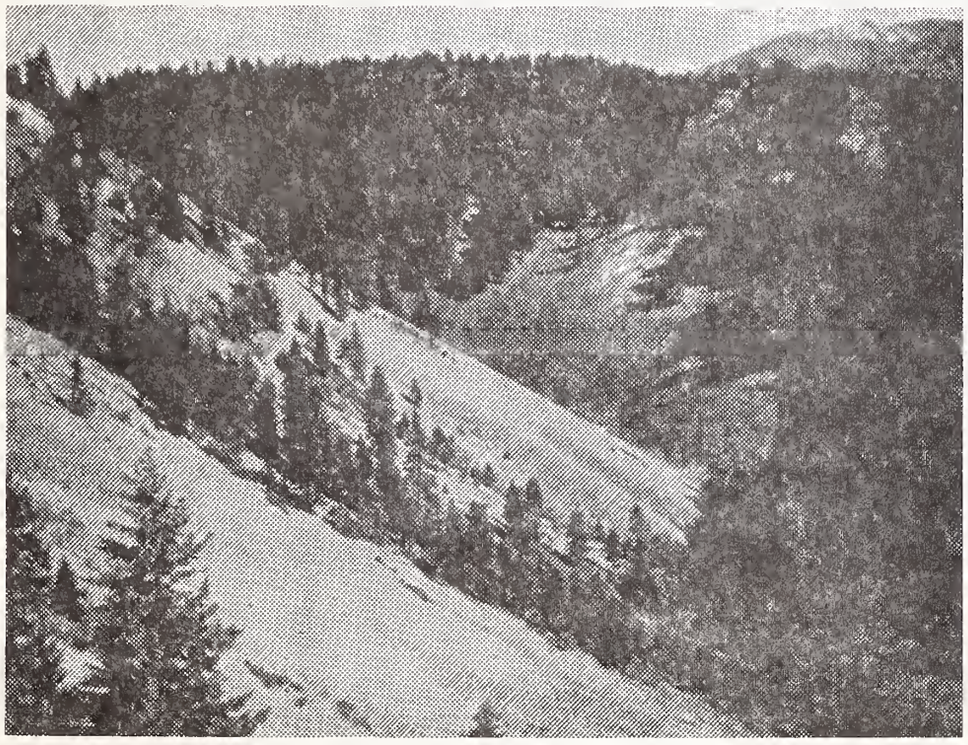
The *Pseudotsuga menziesii* (PSME - Douglas-fir) series is bordered at lower elevations by the *Abies grandis* or *Tsuga heterophylla* series and by the *Abies lasiocarpa* series at higher elevations. Habitat types within this series were recorded on the study area, but little time was spent within this series because of its limited occurrence on mountain goat winter range. Pfister et al. (1977) cites 15 habitat types in this series with roughly 1/3 of these restricted to east of the Continental Divide. The PSME/PHMA (*Physocarpus malvaceus* - ninebark) habitat type was the most common type within this series and occurred primarily on south slopes, giving way to the PSME/LIBO habitat type on north slopes and in moist pockets and to the PSME/VAGL (*Vaccinium globulare* - blue huckleberry) habitat type above. On drier upper elevation slopes within this series the VAGL type gives way to the PSME/CARU (*Calamagrostis rubescens* - pinegrass) type. The PSME/VAGL habitat type generally grades into the ABLA series. The PSME/SYAL (*Symphoricarpos alba* - snowberry) habitat type occurs on warm dry slopes at the lower reaches of this series.



MAP 1

STUDY AREA

The four cover types identified on the study area, in decreasing order of security cover to mountain goats included timber, shrubs, grass/forb, rock/bare ground.



Timber and rock cover types below Spires on Mount Vernon.

Although eight terrain types are identified the cliff, bluff, talus broken and ridge types describe commonly used mountain goat sites, while use of the creekbottom, park and sidehill types was less often observed.

Seven of nine cliff sites were identified as land type 402 which is characterized by glacially scoured U-shaped valley walls having moderate stream dissection, slopes of greater than 65 percent and the lower quarter of the slope having concave configuration. At least parts of four areas were classified as LT 403 which differs from 402 in that it has no drainage pattern, talus is common and the north faces are extremely rocky and steep. This LT is characteristic of high ridges and shallow rocky uplands, the north faces of which were identified as cliff terrain types. One sample area each was in the LT 201 and LT 202 which are oversteepened deeply entrenched drainages.

Grass/forb cover type. Park terrain type.

Shrub cover type in foreground, timber cover type in background. Sidehill terrain type. Ross Creek drainage.

Cliff terrain type in background. Talus terrain type in foreground. Spires area of Mount Vernon.

Portions of eight sites were ELU 60 which is simply described as rock. Three areas each were classed as ELU 57 and 49, both of which are oversteepened sites having very shallow to moderately shallow residual and glacial till, sandy loam soils. Where appropriate the term cirque headwall is used to more clearly describe a cliff site. Precipitation on these sites varies from 30 to 40 inches with 30 to 65 percent occurring as snow. The only consistency in habitat types at these sites is the lack of habitat types, i.e. rock. Subalpine fir, Douglas-fir and grand fir series are represented, with beargrass the most common understory indicator species.

Ten and three bluff-cliff sites of the 15 sampled were at least partially classified in LT 402 and 403, respectively (previously described for cliffs). Land types distinctive of the bluff type include LT 252 (4 sites), 355 (3), 405 (2) and 403 (2). Land type 252 is characterized by slopes of greater than 65 percent on north and east aspects in V-shaped drainages having moderately shallow residual and glacial till soils overlain with loessial deposits. Land type 355 has a slope gradient of 55 percent or less; the land configuration is convex. Land type 405 occurs on strongly frost churned, moderately deep, very cobbly sandy loam soils, at elevations of 5,500 feet or greater, having slopes of 15 to 50 percent. Land

type 403 describes shallow rocky upland soils on slopes of 45 percent or greater. Land type 407 and 408 each occurred once on cliff-bluff sites. The former is composed of deep glacial deposits on 15 to 50 percent slopes above 5,000 feet, while the latter is described as steep glacially scoured valley walls. Twelve ELUs were identified on nine sample sites. The following ELUs described the majority of the sites: 52 (6 sites), 57 (6), 49 (5), 48 (5), 51 (4) and 208 (3). All exhibit oversteepened slopes having shallow soils or strong frost churning. Other ELUs represented included one each of the following: 54, 59, 66, 67, 70, 72. The subalpine fir series is the most common on these sample sites followed by the Douglas-fir, western hemlock and grand fir series. Precipitation on these sites varies from 30 to 90 inches with up to 85 percent in the form of snow. Timber productivity ranges from medium to low. Logging suitability is low to not practical on all but ELU 407 (1 site) and 355 (3 sites) - upon which no logging restrictions have been imposed in the ELU guidelines.

Cirque headwall Middle Fork of Ross Creek.

Bluff terrain type, Wiggletail Creek.

The talus terrain type is described by rocky land types such as 360, 402 and 403 and ELU 60. Vegetative development is nill due to poor or nonexistent soil. Land types most characteristic of the broken terrain type include 402 (3 sites), 405 (2), 403 (2) and 251 (2). Three other LT's each occurring once, were present on broken sites. Land type 402 describes steep glacially scoured valley walls while 405 and 403 are characterized by shallow rocky soils; the former exhibiting strong frost churn action on moderate slopes (20 to 50 percent). Land type 251 occurs on oversteepened slopes having wind blown soil deposits.

Major ecological land units for the broken terrain type were 54 (4 sites), 47 (3), 60 (2), 55 (2) and 57 (2). Ten other ELUs, each represented once, occurred on the sample sites. All of the major ELUs and most of the others are characterized by oversteepened slopes having shallow rocky soils. Precipitation ranges from 30 to 90 inches with up to 85 percent occurring as snow. Subalpine fir habitat types were predominant with three types occurring at seven

Broken terrain type. Head of Big Cherry Creek.

sites while two Douglas-fir types occurred on five sites, one grand fir type occurred at two sites, one western hemlock type occurred on one site and four sites were rock. Harvesting timber in this type is generally not practical. High costs would be incurred with road construction due to large amount of rock in place.

Twenty-five sample ridge sites revealed eight land types which were at high elevations, having slopes ranging from 20 percent to over 65 percent. Soils were characterized by shallow rocky uplands (405), thick cobbly sandy loams (406), moderately to strongly frost churned ground (405) or bare rock (401 and 402). Nineteen ELUs were present on the sample areas with 7 dominating. These included ELU 58 (10 sites), 208 (9), 57 (8), 60 (8), 207 (7), 205 (6) and 55 (5). General characteristics include oversteepened slopes and strong frost churn action. Precipitation on the ridges range up to 110 inches with up to 90 percent occurring as snow. Some areas receive up to 700 inches of snowfall resulting in snow packs of greater than 14 feet. The majority of ridgetop habitat types are in the subalpine fir series. Seven habitat types in this series at 36 sites were recorded, followed by 9 sites characterized by rock, 1 scree site and 2 Douglas-fir habitat types. Timber production is low and the suitability of these areas for logging is low. Road construction would be hampered by much rock in place and the effects of construction would be long lasting.

CHAPTER 3

METHODS

The methods used to develop this plan may be grouped into aerial and ground reconnaissance, laboratory analysis, personal interviews and information solicitation, file searches and literature review. Field work included six aerial surveys (five helicopter and one fixed-wing) of the Cabinet Mountains study area during May, June, July and November-December, 1979 and February and June, 1980. The objective of these surveys was to determine seasonal distribution and relative abundance of mountain goats. During summer of 1979 a field team consisting of two individuals hiked throughout the Cabinets for approximately 2 months observing goats, habitat typing the locations, compiling plant species lists at sample sites and collecting monthly samples of mountain goat pellet groups. I made numerous ground trips into remote portions of the study area from April 1977 through August 1980.

One gram composite subsamples from 5-7 pellet groups collected for each monthly or seasonal period were sent to the Composition Analysis Laboratory at Colorado State University for histological identification of food items in the diet. Two hundred fields per sample were analyzed.

A net corral trap was established on Mount Vernon to capture, mark and monitor goats. The trap was attended for several weeks during which time a female goat accompanied by a kid was captured and fitted with a radio transmitter. Subsequent radio locations of this animal were made from both the air and ground.

A collection of historic and recent mountain goat sightings was obtained from available reports and local residents. Observations were plotted on an overlay of a 1 inch per mile topographic map and coded by season. Final maps were derived by circumscribing concentration areas of observations then refining the boundary on the basis of terrain type and elevation (usually 5,000 feet or above). Snow depth indices were determined for 65 sites in the Cainbet Mountains using the procedure outlined in Appendix 2. General cover and terrain types were mapped onto 1:24,000 topographic maps through interpretation of infrared aerial photographs. Hard rock mining claim data for the study area was obtained from the Montana and Idaho offices of the Bureau of Land Management and mapped. Fire history maps from each ranger district were consolidated and various fire management plans for portions of the national forest were reviewed. Five-year timber sale plans and cutting unit data from stand atlases from each ranger district were compiled and mapped. The 1980 Kootenai National Forest Travel Plan was analyzed and a listing of existing trails on the study area was compiled. Seven Forest Service planning unit documents which encompassed portions of the study area were reviewed. Land ownership maps, the

Cabinet Mountains Wilderness Management Plan and hunter harvest statistics for mountain goats taken in the Cabinets were reviewed. A comprehensive review of mountain goat literature was conducted.

All observations of goats by project personnel, whether from the air or ground, were recorded on the form which is included in Appendix 1. All locations of sign and observations of mountain goats were recorded according to one of four natural cover types. The cover type of the immediate location was assessed either quantitatively at sample sites of mountain goat use by pacing out a 1/10 acre circular plot or by making an ocular estimate from the air. Combinations of cover types were the norm. For example, a site having all four types would be recorded as timber or timber and shrub, depending upon whether timber in itself was sufficient to conceal a goat. The grass/forb or rock/bare ground categories did not afford cover and were listed only if they composed at least 1/3 of the plot area.

The forest habitat typing system developed by Pfister et al. (1977) was used to describe mountain goat use sites on the ground and from the air. Since not all goat use sites which were observed from the air were visited on the ground, reference was made to habitat type maps compiled on each ranger district to determine the habitat type present at the observation point. This procedure was abandoned after spot ground checks and comparison of map boundaries revealed some inconsistency. The overstory climax tree species defines the series within which several habitat types occur; so designation of a site to series level was often the most refined classification possible from the air.

All sign and observations of mountain goats were recorded according to one of eight terrain types. The following four terms describe rocky terrain types:

CLIFFS - rock faces several feet in height
BLUFFS - benches with rock drop-offs, often in step-like formation
TALUS - masses of shale or boulders, generally not capable of supporting vegetation to climax stage due to instability or poor edaphic features
BROKEN - those areas which are not bluffs, cliffs or talus but which were obviously difficult to traverse because of rocky substrates

If an area could not be defined by one of the rocky terrain types, then it was classified as one of the four remaining types including:

RIDGE - the line of land seperating two drainages
CREEKBOTTOM - bottom of a drainage or line of land where opposing sidehills meet
PARK - a nontimbered flat or sloping area
SIDEHILL - a catch-all term used to categorize any nonrocky area which would not fit any of the other terrain types

The talus and park types by definition were not timbered but the six remaining terrain types could support any cover type. Cliff, bluff and broken terrain types provided escape terrain which is defined as those areas providing maximum terrain security to goats.

The use of terrain type terms are logical and useful in the field. To technically describe each term, representative terrain types were identified on 1.25 inch per mile topographic maps from the Troy Ranger District planning guide. Land type and ecological land unit overlays of each area were superimposed to determine which land types (LT) and ecological land units (ELU) best described each terrain type. This process, was applied to 27 percent of the study area (the portion of the area covered in the planning guide). A single observation often involved use of more than one terrain type and often the land configuration was such that terrain types occurred in a mosaic. All terrain types except cliff and ridge occurred in conjunction with another type; or, as in the case of sidehills and creekbottoms the LTs and ELUs were so varied as to be impossible to describe in general terms. Mountain goats were so rarely observed in the creekbottom and park terrain types that these types were not sampled on the topographic maps. This is not to say that either type is unimportant to goats, but the sites are either used on a short-term basis or the type of site is difficult to inventory from the air due to low visibility (creekbottoms). Land type designations represent a coalition of data on geology, soils and landform. The majority of mountain goat use areas fall into the alpine glaciation land type series. Ecological land units are derived from combinations of land types and habitat types. Each unit is rated with respect to its ability to serve certain functions or sustain particular activities. One such function is the ability of a given piece of land to provide wildlife winter range. Several ELUs rated as having no or low suitability as wildlife winter range actually do support mountain goats and could be inadvertently mismanaged as a result of a low rating for winter range suitability - leading to adverse effects on the habitat's ability to sustain wintering populations.

Nine cliff sites were selected from the Troy Ranger District planning guide and described according to LTs and ELUs, as were 15 bluff-cliff sites and 25 ridge sites. Ten areas classifed as broken were combined with either the cliff or sidehill terrain types and analyzed.

CHAPTER 4

A REVIEW OF MOUNTAIN GOAT ECOLOGY

In order to develop a more complete understanding of the unique ecology of mountain goats a review of information about their physical and behavioral characteristics, population dynamics and structure and food habits is presented. Such an understanding is a necessary prerequisite in interpreting information collected during this study and in predicting the response and adaptability of mountain goats to human activities and habitat alterations.

Physical Characteristics

The mountain goat (*Oreamnos americanus* Blainville 1816), a member of the Bovidae family, is the only living member of its genus. Its closest relatives are the goat-antelopes of Europe and Asia (Rideout and Hoffman 1975).

The coat of the mountain goat distinguishes it as the only big game animal in the 48 contiguous United States which is cloaked in white. The fine dense wool of the undercoat is hidden by guard hairs which may attain a length of 8 to 9 inches or more (Chadwick 1973, S. Stewart personal communication). The sexes of mountain goats are physically so similar as to make it difficult to distinguish them. Essential to understanding the population dynamics of mountain goats in a particular area and thus the herd's status and trend, is accurate sex and age classification of individual animals. Certain features can be used in the field to distinguish between the sexes depending upon the season and the animal's age. Mountain goats go through a distinct molting process (Chadwick 1973). Males generally initiate shedding in May - completing the process 2 to 3 weeks ahead of other goats, while barren females follow, completing the molt by late July or early August. Females with kids, apparently as an energy conservation adaptation during the nutritionally demanding period of bearing and rearing young, do not begin the molt until late June or early July and do not complete the process until August. Yearlings are among the last to complete shedding and may not sport a new coat until September. Kids do not shed their first year. The pattern of molt follows from the head and neck regions and progresses posteriorly to the rump. Based on geographical location, the degree of molt and the portion of the month during which classification of an animal is being attempted the molting pattern can be an aid in identifying the age and sex of goats.

Urination posture is another useful way to determine the sex of an animal. Females assume a squatting position while males stretch the front legs forward.

Molting begins in the head and neck region and progresses posteriorly. Timing and pattern of molt can be used to distinguish sex of the goat.

Determining the sex of an animal based on body size is difficult, but is particularly so for animals less than 4 years of age (Casebeer et al. 1950). Newborns of both sexes range from 6 to 8 pounds and stand about 14 inches at the shoulder while yearlings average 45 pounds and stand 24 inches at the shoulder. Two year olds range from 60 to 65 pounds and average 28 inches at the shoulder. Full growth is probably reached by 4 years. From a sample of 29 animals (Casebeer et al. 1950) adult females averaged 126 pounds and stood 34 inches at the shoulder while adult males average 134 pounds and stood 38 inches at the shoulder. Brandborg (1950) indicated that adult females average 10 to 20 percent smaller than adult males and average 135 pounds as compared to 175 pounds for males. He stated that maximum weights ranged from 250 to 300 pounds for adult males but Casebeer et al. (1950) indicated that in Montana mountain goats rarely attain 200 pounds, although Lentfer (1955) demonstrated that after goats have been transplanted to a suitable new location, offspring may attain larger body sizes than the original transplant stock.

Both males and females have shiny, black dagger-like horns. In general the horns of the male are thicker at the base and curve slightly back in a uniform arc while those of females are more slender and upright with what little curvature exists occurring mainly toward the upper third of the horn. Black leathery spots occur on the top of a newborn's head, which grow into 4 inch horns during the goat's first year. By 2 years the horns have reached from 6 to 7½ inches (Chadwick 1973, Brandborg 1955, Lentfer 1955). Little growth occurs during winter months once the goat reaches 1 year of age. Normal adult horn lengths range from 8 to 10 inches. Horn measurements taken from five of seven animals released in the West Cabinet Mountains during a transplant from the Olympic National Park in Washington during July 1980 were as follows: 8-9 year old female - length 8.1 inches, circumference 3.9 inches; 4 year female - length 7.75 inches, circumference 4 inches; 3 year female - length 8.1 inches, circumference 3.75 inches; 1 year male - length 5.75 inches, circumference 4.1 inches.

Casebeer et al. (1950) describes the hooves of mountain goats as compared to deer and bighorn sheep (*Ovis canadensis*) as rectangular or squarish in appearance i.e. the sides of the hooves are parallel. Deer have heart shaped hooves and those of sheep are slightly concave along the exterior edges. In snow or soft soil, the bottoms of the hooves leave concave depressions rather than convex (deer and sheep) because of the spongy thick tissue on the bottom of the feet which help reduce slippage.

The size, shape and consistency of the feces varies with seasonal food habits. Spring droppings are often amorphous as a result of the animal's foraging on lush vegetation. It is often difficult to distinguish between deer and goat pellets, but in general goat pellets are smaller with one end pointed and the other concave.

Reproduction

Males are physiologically capable of breeding at 18 months (Henderson and O'Gara 1978) but generally do not do so until 30 months. Females generally first participate in breeding activities at 30 months (Lentfer 1955). Estrous lasts about 72 hours with most females exhibiting receptive behavior about the same time (Chadwick 1973). Breeding intensity is reached the middle to end of November although the range of observed mating is from October to early January (Geist 1964). Gestation lasts for 6 months (178 days according to Brandborg 1955 and Seton 1927) with newborn kids arriving during late May and June. The birth period lasts for slightly over 1 month (Chadwick 1973, Anderson 1940, Hanson 1950). Females nearing parturition seek out rugged steep terrain providing high security and remain in the general vicinity of the birth site for 1 to 3 weeks after young are born (Chadwick 1973). Smith (1976) indicated that adult females give birth on winter ranges although prior to the birth period females may move to kidding grounds which do not occur on their winter range. Chadwick (1973) believed that traditional kidding areas may exist which receive use from females from other areas. The Mount

Vernon Spires area in the Cabinet Mountains is a confirmed kidding grounds. A newborn kid and its dam were observed on June 4, 1978 on the northeast face of the Spires. Two weeks later five goats, including two newborn kids, were observed in the same area. On June 24, 1979, a female and kid were captured in the corral trap which had been set on Mount Vernon. This information suggests that the entire month of June and probably late May is critical to mountain goats using the Spires. Whether this area is used by females from other wintering areas who come here to give birth is not known.

Single births are most common but twins do occur and in areas of expanding population, as in the case of the Crazy Mountains transplant in Montana, triplets were not uncommon (Lentfer 1955). No confirmed instances of twinning was observed in the Cabinet Mountains during this study. Females probably give birth each year since they are often observed being followed by both a kid and a yearling (Casebeer et al. 1950). The reproduction cycle (period between births) probably fluctuates with age and nutritional conditions. Maximum breeding age is not known.

Young are nursed hourly for the first several days, but by the second week nursing attempts are being rejected by the mother and by week 4 young are weaned (Casebeer et al. 1950).

Mortality

Age-Specific

Casebeer et al. (1950), Brandborg (1955) and others indicate that the heaviest yearly losses to populations occur in the kid cohort before they reach the age of 1 year. Anderson (1940) documented that depending upon the winter conditions, from 20 to 80 percent of a year's kid crop would be lost. Kids separated from their mothers have a reduced chance of survival and their odds of survival decrease as winter severity increases (Kuck 1977a, Brandborg 1955, Chadwick 1973, Rideout 1974). Investigators agree that the majority of mortality in all age groups occurs during winter months (Casebeer et al. 1950, Brandborg 1955, Smith 1976).

The age to which the average adult mountain goat lives is between 10 and 15 years (Casebeer et al. 1950). Smith (1976) quotes 10.3 years as the average longevity while Richardson (1971) cites 10 years for females and 11 years for males. A female goat from a transplant made 12 years previously was observed in the Crazy Mountains. She had been an adult at the time of transplant (Lentfer 1955).

Natural Causes

The severe winter weather which normally occurs in mountain goat country predisposes goats to accidents. Snow, rain, temperature and

wind conditions singly or in combinations, create hazardous travel in steep terrain. Winter range is selected for its snow shedding qualities (Smith 1976) which exist because of favorable combinations of slope, aspect and elevation. Selection of winter range is based primarily upon the area's ability to minimize winter energy demands and secondarily to provide forage. A wintering site which meets these criteria is essential for survival of goats. It becomes easier to understand the reason why mountain goats have such strong fidelity to their winter ranges, when the alternative of seeking out new sites on a year to year basis would result in extreme winter mortality. Many accounts detail the falls and resultant injuries and deaths of mountain goats.

During the Cabinet Mountains study an adult male with a broken horn, the sheath still attached at an odd angle, was observed. He may have been suffering from other injuries since he stood motionless at a distance from the helicopter at which most other goats move away or nervously stomp and turn. An adult male was also seen moving steadily through broken terrain on three legs holding up a front leg. The leg was visibly swollen at the ankle joint. A hunter reported seeing a goat with an apparent broken leg in the same area 3 years previously (J. Brown personal communication). A 10 year old female was found dead just below Rock Creek Meadows on a bluff above the road. Cause of death was unknown but examination of the femur marrow indicated that she had been suffering from malnutrition. Malnutrition can be a cause of death in itself, but more often it predisposes the animal to predation and disease. The bleached bones and skull of a mountain goat were found at the bottom of the talus slope below the Spires of Mount Vernon.

Dead goat found just above road near Rock Creek meadows. Mountain goats have a very high natural mortality rate.

Documented accounts exist of bald eagles (*Aquila chrysaetos*) (Casebeer et al. 1950), golden eagles (*Haliaeetus leucocephalus*) (Seton 1927), mountain lions (*Felis concolor*) (Hornocker 1970) and wolverines (*Gulo gulo*) (Guiguet 1951 in Smith 1976) killing mountain goats. Both black bear (*Ursus americanus*) and grizzly bear (*Ursus arctos*) are thought to prey upon goats (Cowan 1944) and lynx (*Lynx canadensis*) and bobcats (*Lynx rufus*) are capable of killing at least young goats (Chadwick 1973). Eighteen percent of 49 coyote (*Canis latrans*) scats examined by Casebeer et al. (1950) contained mountain goat hair and six of eight goat carcasses located in the field had been eaten by coyotes. Most researchers felt that coyotes primarily scavenge goat carcasses. The golden eagle is the goat's most efficient predator (Anderson 1940, Brandborg 1955, Parratt 1964, Seton 1927), but mountain lions are also effective (Cowan 1944, Hornocker 1970). In the Cabinet Mountains all of the aforementioned animals occur (Joslin 1980) and may prey upon mountain goats or at least scavenge their remains. Golden eagles and sign of mountain lions have been regularly noted near the Ross Point and Mount Vernon goat ranges. It is difficult to establish the overall effect of predation upon a mountain goat population (Casebeer et al. 1950) but "one must remeber that traditional use of their native, cliffy habitat may have evolved partially through selective pressures created by predation" (Smith 1976).

Parasites and disease may cause death but most often such afflictions weaken animals which may then succumb from some other cause. Brandborg (1955) states that "animals which appear to be healthy may support reservoir populations of internal and external parasites without succumbing to their effects, unless infestations become unusually heavy during periods of adversity." Endemic health afflictions of the Cabinet Mountains goat population was not researched, however, wood ticks (*Dermacentor andersoni*) and winter ticks (*Dermacentor albipictus*) are known to occur on the study area.

Man Caused

Direct man caused mortality involves legal and illegal hunting. Mountain goats are particularly vulnerable to human predators because they derive a sense of security from their cliffy environment. Goat response to most predators involves selection of a high vantage point to which it can escape and observe - but man, as a predator, need not enter that environment to kill a goat. Poaching by its very nature is difficult to document and more so to control. Poaching of mountain goats is greatly facilitated by roads into goat terrain, so it follows that poaching has been most prevalent at accessible sites since it is not likely that the offender will take the risk of being caught if he must gain access to an area on foot.

Much more insidious a threat to mountain goats than all other causes of mortality is the indirect type from human civilization, for

it exerts a constant and growing pressure from a multitude of factors. Each factor has its own effects but combined with one or several other factors the results are more than additive. Human influences become synergistic so that the total effect on mountain goats is much greater than the sum of the parts. Housing developments, near mountain goat range, result in more people, more traffic, more recreationists, more domestic pets, more noise, more demand for timber and minerals. In short, more opportunity for people seeking commodities and recreation to come in contact with mountain goats. The nebulous character of this type mortality may be summarized by one word: stress.

Stress is described in medical terms by Guyton (1971) as the state which elicits in the sympathetic nervous system a mass sympathetic discharge resulting in increased activity of many functions of the body including increase in arterial pressure, increase in blood supply to the tissues, in rate of cellular metabolism throughout the body, blood glucose concentration, rate of blood coagulation and even mental activity. In describing the physicological effects of stressful winter conditions upon female bighorn sheep Geist (1971) states:

> In addition to the fetal demands the pregnant female must compensate for heat loss due to cold and wind, the increased mechanical energy expended in removing snow from forage and moving through snow, as well as escaping from the predators and the energy loss due to a rise in metabolism when excited (Graham 1962). In extreme conditions of cold and snow, when ewes are restricted to small areas, when they even become antagonistic to their own lambs and chase them from available forage, the ewes are very likely to become stressed and increase their plasma cortisol and size of adrenal glands (Reid 1962). Psychological stress may produce here a far greater adrenocortical response than the climatic stressors (Reid and Miles 1962). This could be most unfortunate for the fetus.

The results of stress will vary depending upon the level of disturbance and may be manifest in future generations through decreased fetal and neonate survival. Those who do survive may suffer from nervous disorders and under development (Alexander and Peterson 1961). While stress occurs in normal situations, it is magnified by human disturbance. Liddell (1958 and 1961) found that under conditions of psychic stress mountain goats lose weight, while their new horn growth is soft and easily scraped away with a finger. The effects of stress are less obvious than any other mortality factor but it is much more serious in that it has the capacity to simultaneously affect entire herds. While it may seem odd to describe stress as a cause of mortality it has just as terminal an effect as falling from a cliff. Chronic stress may generate low birth rates, poor survival and vitality with ample opportunity for the ultimate demise of the herd. At fault is any human activity or associated factor (habitat disruption, domestic pet harassment, etc.) which raises the anxiety level, increases movements, unnaturally congregates animals and/or decreases normal activities.

In the past mountain goat populations maintained themselves because their habitat was inaccessible, but today human activities are encroaching upon their range. Regardless of the mechanism of interaction, the ultimate result of a close association between humans and mountain goats seems to be the eventual reduction or elimination of goats.

Food Habits

Seasonal

Mountain goats are adaptable foragers. They utilize available forage, which may differ markedly depending on geographic location. Summer food habits studies conducted in the Crazy Mountains by Saunders (1955) and in Banff and Jasper Provincial Parks by Cowan (1944) indicate that grasses were the primary food category used by goats followed by forbs and shrubs, while Casebeer (1948) in the Bob Marshall Wilderness Area found that shrubs (96 percent *Vaccinium scoparium*) were the primary food source followed by grasses and forbs. Klein (1953) in Alaska and Smith (1976) in the Bitterroot Mountains found that grasses were primarily used and Chadwick (1973) in the Swan Range found forbs to be the most important summer food item. During the snow free summer priod goats are able to be selective in their forage intake. In four of nine reports on the food habits of mountain goats, grasses were the primary winter forage group while shrubs were first in four of the investigations(Anderson 1940, Casebeer et al. 1950, Hanson 1950, Harmon 1944, Hibbs 1966, Kuck 1977, Peck 1972, Saunders 1955, Smith 1976). Conifers received considerable winter use as noted by Brandborg (1955), Chadwick (1973), Geist (1971), Hanson (1950) and Saunders (1955). Geist (1971) indicates that conifers are a very important food item and although they function initially to fill the rumen (goats fed heavily on *Abies lasiocarpa* at the start of feeding periods) they are selected even after other forage becomes available in the spring by digging through snow to reach the layered branches of subalpine fir. L. Adams (personal communication) indicates that goats go out of their way to feed on conifers in the Sheep Mountain area of Colorado. Several researchers indicated that beargrass (*Xerophyllum tenax*) is an important food item during all or part of the year (Chadwick 1973, Casebeer et al. 1950, Smith 1976).

Nutrition

The use of mineral licks by mountain goats likely fills an important physiological role (Hebert and Cowan 1971). Observers have recorded the use of natural and artificial lick sites during spring and early summer on most mountain goat ranges. Sodium is the mineral usually being sought by ungulates, particularly sodium bicarbonate as shown by Stockstad (1953) and Smith (1954). According to Hebert and Cowan's (1971) work in British Columbia, sodium is deficient in the diet of mountain goats during spring, which is also the time abrupt sodium losses occur through the fecal route. Brandborg (1955) indicates that as little as 20 ppm of sodium attracts goats in some areas of Idaho.

Males generally use mineral licks during spring while females use the sites in summer (Brandborg 1955, Hebert 1967, McCrory 1965, DeBock 1970). Later use of licks by females coincides with their arrival from kidding grounds.

Food habits information has value to the manager not only for assessing forage use and range condition but perhaps more importantly in assessing the nutritional level of a population's diet. Hebert (1978) explains that "there has been a gradual shift from assessment of carrying capacity by vegetation utilization studies and change in population characteristics to that of establishment of nutritional status of wild populations." While such an analysis requires intensive precise physiological data collection the results can provide the manager with valuable information. Physiological parameters to be tested include blood urea nitrogen, fecal nitrogen, nonesterified fatty acid levels and triglycerides which reflect anabolic or catabolic digestion, protein intake, energy intake and overall nutritional status. Hebert (1978) found in testing an experimental and control group of bighorn sheep ewes that the group which was fed high quality summer forage and then was shifted to low quality winter forage to simulate a migrating herd maintained a high nutritional status as compared to the group held on low quality forage. His findings support the contention of Pitt and Wilkeem (1978) that "quality of summer diet affects the ability of animals to survive winter stress, as unthrifty animals at the beginning of winter are less likely to survive until spring even if winter conditions are relatively mild." Blood chemistry values can be used to address variables of population productivity, recruitment and overwinter mortality. The sampling procedure must quantify the time period an animal or population is at submaintenance levels as well as the point in time when dietary shifts force changes between catabolic and anabolic states (Hebert 1978).

If blood chemistry baseline data can be obtained for a particular herd than crude protein values of available forage can be used to more effectively guide the manager's habitat manipulation programs based on known seasonal dietary deficiencies. Dietz (1971) states that even a slight deficiency in protein in the diet can be detrimental to reproduction, lactation, growth and fattening processes. Protein is used for body building and maintenance and is important in sustaining a healthy microflora in the rumen.

Although summer range is the bulwark of an animal's nutritional status the animal must nevertheless eat during winter and Geist (1971) postulates that in late winter bighorn ewes must get most of their energy for maintenance and reproduction from winter forage. Smith (1976) attributed particularly low natality during one year to a mountain goat herd in the Bitterroot Mountains to inutero or neonatal losses precipitated by winter stress and delayed green-up. Hjeljord (1973), Cowan (1944), Ballard (1977), Rideout (1974), Hibbs (1966), Thompson and Guenzel (1978) and Brandborg (1955) attribute low survival and production of young to adverse wintering conditions, resulting in lowered availability of foods and use of those of poor nutritional quality.

Deer experience weight loss as winter progresses and Moen (1978) has shown that this reduction occurs even if unlimited food supplies are available. This seasonal weight loss appears to be an adaptation to normally reduced winter forage availability; a reduced body mass requires less to maintain. Casebeer et al. (1950) cites weight losses in mountain goats during winter but indicates that no information is available regarding weight fluctuations.

Social Structure

Dominance Hierarchy

The following social linear dominance order often occurs in mountain goat society during winter conditions: barren female, female with kid, 2-year male, 2-year female, adult male, yearling and kid. Although an older barren female may dominate, a female with a kid is usually the group leader (Chadwick 1973, Smith 1976). Within a given cohort, sex, size and aggressiveness establishes dominance with the larger or more aggressive animal attaining top rank. Between sexes an apparent reversal in dominance occurs at about 3 years of age. Until this age males dominate females of the same or lesser age class. By the third year males are more and more inhibited in their encounters and eventually adopt a solitary existence. There is distinct survival significance in this pseudo-subordinate adaptation since it is in the best interest of the species as a whole that the female assume a dominate position in order to occupy the best habitat to rear young while the male contribution to the species is to breed as many females as possible thus ensuring the future of his genetic component (Trivers 1972). Adult males have been observed to relinquish feeding and bedding sites even to kids. A barren female may dominate a group but a female with kid usually determines the direction and sequence of activities within the group. Mountain goat social structure is flexible and depends to a large extent on environmental conditions, population density and herd composition (Rideout 1974). Where food is common, males and females rarely come in contact with one another (Rideout 1974) but when food is limited females become dominant over males (Chadwick 1973).

Grouping

Mountain goat social structure encourages formation of small widely spaced groups (Rideout 1974). Smith (1976) enumerates several reasons why formation of large groups would not be advantageous to the species. First, the broken nature of the terrain and disperse food source would favor small groups so that maximum use of the available food source could be achieved with little likelihood of degradation of small areas from overuse. Second, small groups would decrease the potential for intraspecific competition thus lowering aggression rates and conserving energy under adverse conditions. Third, grouping for mutual protection would be unnecessary since a single mountain goat equipped with lethal horns and inhabiting dangerous terrain is a formidable opponent; protection grouping would increase the potential for accidents which could terminate an entire group (avalanche).

The only permanent associations between individuals are 10 to 11 month long female-kid pairs (Stevens and Driver 1978, Smith 1976). Brandborg (1955) indicates that spring group size reaches a low just prior to the kidding period when females are seeking solitude, other animals are dispersing from the winter range and new yearlings are abandoned. Females with new kids band together in late June and July forming nursery groups which may also include barren females and subadults who are attempting to maintain maternal bonds. The largest groups are often observed at this time of year. Later in the summer, groups disband in search of increasingly succulent vegetation. The fall breeding season brings an increase in group size as males join females but they disperse rapidly after the first week of January (Smith 1976). Depending on the environment, winter group sizes may increase if animals are congregated on windswept ridges (Chadwick 1973, Lentfer 1955 and Casebeer et al. 1950) or they may decrease if winter range occurs on limited cliffs. As explained by Smith (1976) the latter situation would be "advantageous for safety and resource reasons." Adult males and barren females are often solitary for the majority of the year. Males have been seen in areas seldom or never used by females and subadults (Chadwick 1973).

Behavior

Significance of Traditional Seasonal Behavior

Important to proper management of mountain goats is an understanding of their unique biological needs which require special management. Mountain goats have evolved over thousands of years in a relatively stable environment. A stable environment, for several reasons, fosters predictable, stable behavior (Geist 1971). Animals evolving under such conditions do not have strong exploratory tendencies. Traditional behavior patterns are adaptive to survival of mountain goats through passage of home range knowledge from generation to generation through predictable seasonal use. Traditional seasonal behavior accommodates full use of available habitat without the need for pioneering tendencies. Members of the deer family have evolved with a social strategy having latitude to adapt to different and changing environments and for this reason they have strong pioneering abilities (Geist 1971). Unlike deer, elk or moose (*Alces alces*), but similar to bighorn sheep, mountain goats have evolved a restricted behavior in order to most efficiently exploit the niche of rigorous environment which they occupy.

Females are more rigid in their use of seasonal ranges than males because rearing young requires the best available resources which can be predictably provided using the least amount of energy i.e., drawing upon home range knowledge. Since mountain goat defense mechanisms revolve around rugged terrain, regular seasonal use patterns of familiar terrain is essential for survival. The female who ventures out on exploratory excursions jeopardizes not only her immediate safety and that of her current offspring, but also her genotypic contribution to the species. As she strays from familiar terrain her ability to defend

herself and her offspring from predators decreases. High fidelity to seasonal ranges has been noted by numerous researchers (Stevens and Driver 1978,Hibbs 1966, Smith 1976, Brandborg 1955, Chadwick 1973). The male on the other hand may stray into new terrain but his survival is less important since his contribution to the species occurs once per year during the mating season. During this time he may mate with several females and thus increase his odds of ensuring his genetic component. The fact that males lead a solitary existence usually in more rigorous habitats in itself contributes to the welfare of the species since they do not then compete with females for resources (prime habitat and forage).

If traditional use patterns are altered and seasonal home range knowledge is not transferred to offspring then suitable, unoccupied ranges may not be recolonized. This could occur if adults, with their knowledge of home range, are prevented from passing on the traditions. This may happen for two reasons. First, if use patterns are altered in response to an activity. A project of as short duration as 5 to 8 years may prevent a generation of mountain goats from becoming familiar with the range. Second, if goats in an area are removed, the pioneering limitations of adjacent herds are likely to keep this area from becoming reinhabited - at least quickly.

Daily and Seasonal Activities

In the spring, with increased availability of forage, the number and duration of feeding periods increases and alternates with bedding periods at 1.5 to 3 hour intervals (Chadwick 1973). Some animals in all age groups are active during all hours of the day and night but Rideout (1974) found that activity was reduced during the night and during the Cabinet Mountains investigation goats which were observed bedded at dusk were often seen in the same spot at dawn. As temperatures increase the daytime bedding period lengthen which tends to synchronize the evening feeding periods. During this study and as reported by Chadwick (1973) evening observation periods proved the most rewarding. As summer heat desiccates vegetation and prompts goats to select cool sites for thermoregulation, mountain goats become less observable (Brandborg 1955). Chadwick (1973) felt that an equal amount of time was spent feeding during winter and summer although more energy may be used to feed during winter. Geist (1971) observed goats pawing through snow from a variety of postures. Standing on their hind legs goats were seen to stretch up to grasp limbs from overhanging bluffs on Mount Vernon.

Bed sites nearly always occupy a vantage point having a view below. Goat bedding areas are used for generations so that fecal pellets build up to a depth of several inches. Dust bathing is done by goats of all ages and consists of pawning the ground to expose or loosen the soil, then lying down on the spot and flinging dirt posteriorly with the foreleg. The procedure may be repeated on the opposite side of the body. Dust bathing is thought to relieve discomfort from ectoparasites and general skin irritation (Brandborg 1955).

Standing is passive activity engaged in by goats on a regular and extended basis. As compared to the nervous active watchfulness of deer, goats will often stand motionless for several minutes (Chadwick 1973). For an animal having a largely solitary existence this type behavior has defense advantages. It has been found that domestic sheep produce up to 15 percent more body heat by standing (Vaughn 1975) and Smith (1976) felt that this may have been true for mountain goats as he observed 15 percent of the wintering groups standing while none were observed standing during summer.

Research on elk shows that in selecting areas for thermoregulation elk choose clumps of vegetation whose configuration, canopy cover, slope, exposure and tree size influence the microclimate (Beall 1973). Although quantified information is not available regarding mountain goat thermoregulatory behavior several observers (Chadwick 1973, Peck 1972, Saunders 1955) noted that they choose microsites within their habitat which modify the effects of ambient meterological conditions and solar and thermal radiation conditions.

CHAPTER 5

RESULTS AND DISCUSSION

Historic Distribution

Continental

Mountain goats are native to western North America (Figure 1). They are speculated to have crossed the Bearing Strait land bridge from Asia to North America during the early Pleistocene along with numerous other animals (Hibbs 1966). Mountain goats occurred as far south as California, Arizona and New Mexico as evidenced by fossil remains (Whitney et al. 1904 in Hibbs 1966). The evolutionary history of mountain goats is poorly understood, since their remains are not well preserved in the harsh mountainous terrain which they occupied. (Simpson 1945).

The current southern distribution of mountain goats extends to near the Snake River Plain of Idaho while the southeast border is in Montana. To the north, they occur in Alberta, British Columbia, Yukon and Northwest territories and Alaska. Mountain goats have been introduced to Colorado (1948), South Dakota (1924), Nevada (1964), Oregon (1950), Utah (1967) and Wyoming (1955), (Johnson 1977b).

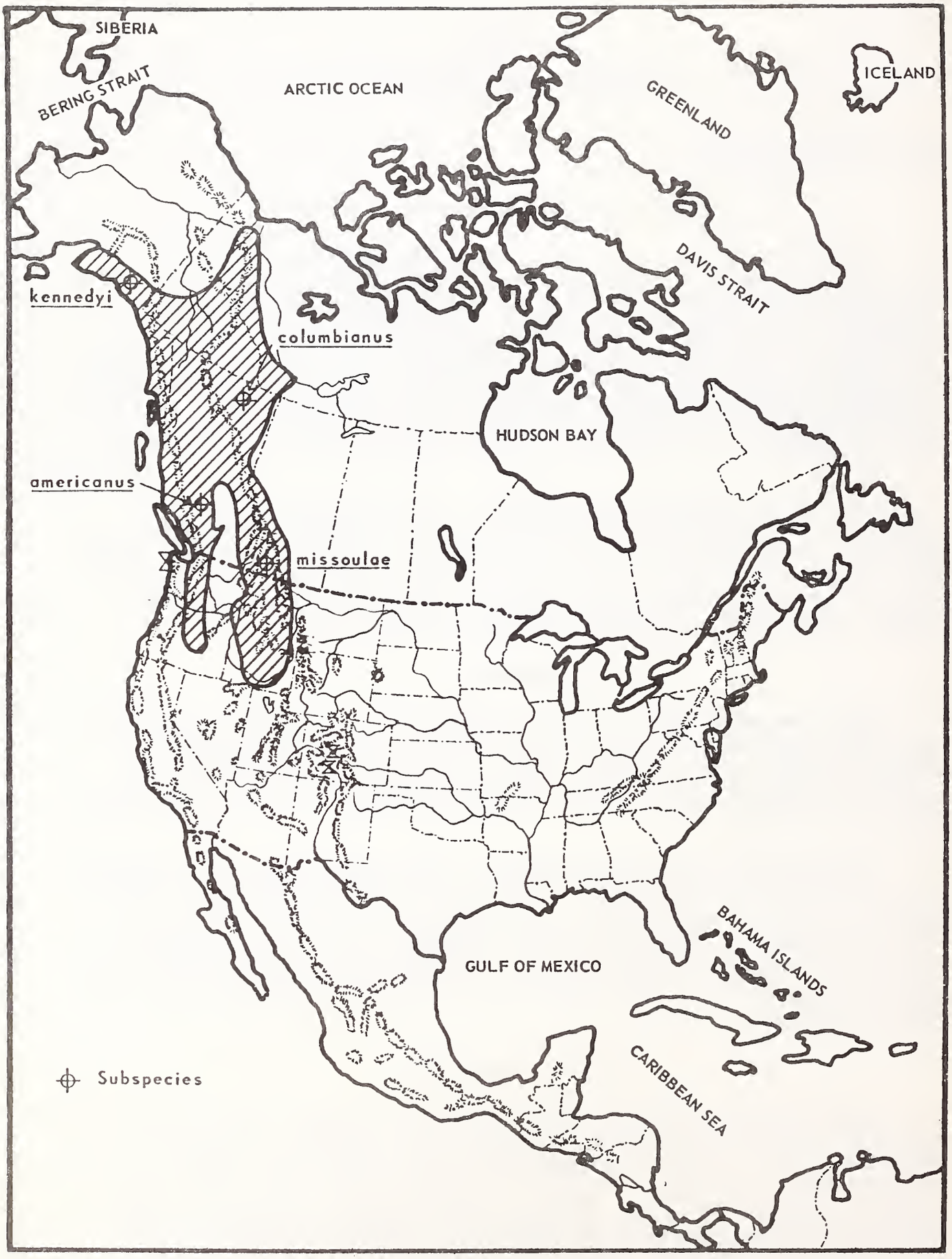
Montana

Native mountain goat herds are located in 12 geographic locations throughout Montana. All are located on or west of the Continental Divide (Casebeer et al. 1950). The lack of pioneering ability prevented the mountain goat from extending its range to isolated mountains east of the Divide.

Transplanting records from 1910 to 1980 indicate that 372 mountain goats were transplanted within and outside of Montana during 34 transplants (McLucas in preparation). Of the total, 350 have been placed at 21 locations in 12 Montana counties while 14 and 8 were shipped to Colorado and Wyoming, respectively. Currently the mountain goat transplant program is at an ebb since little suitable unoccupied habitat remains in Montana.

Cabinet Mountains

Mountain goat distribution in the Cabinet Mountains was first addressed in the literature by Casebeer et al. (1950). During 1947, two Department of Fish & Game employees made a short trip into the Cabinets in the vicinity of A Peak, Snowshoe Creek, Cherry Creek and Carney Peak (Casebeer et al. 1950). They describe the mountain goat range as starting just west of Libby and extending southeast to the West Fork of the Thompson River. They indicate that the core of the herd was centered around A Peak and the North Fork of the Bull River. An observation of 10 goats on Billiard Table Mountain is the only



(Hall and Kelson, 1959)

Figure 1. Native distribution of mountain goats in North America.

reference made to the West Cabinets Mountains, and a group of 14 was observed along Trout Creek south of the Clark Fork River. Casebeer et al. (1950) state that the Cabinet Mountains herd "is probably a remnant of a larger herd that ranged further than at present, but was still centered in the Cabinet Range." Burleigh (1978) addressed the historic and present distribution and status of mountain goats in the southern Cabinet Mountains, on the Lolo National Forest. His work indicates that six winter ranges were used by goats in the past but only 3 are currently in use. In an interview, the late Clifford Wier (70 plus years resident of northwest Montana) said that early in the century goats were numerous in Swamp Creek at the southern end of the study area. He described a rock overhang in the drainage which he and his father discovered in the 1910's that sheltered wintering goats. B. Robinson (personal communication) reported killing one goat and observing two others in Swamp Creek in 1969. During the current study 1 and 4 goats were seen in Swamp Creek during surveys. A series of 4 parallel drainages on the east side of the East Cabinet Mountains, including Bear, Cable, Poorman and Ramsey creeks, appeared to have suitable wintering terrain and were reported by local residents (J. Brown, personal communication) to winter goats. A. Shelden (personal communication to J. Brown)reported seeing in August 1956, 20 goats on the ridge between Poorman and Ramsey creeks with the majority in the latter drainage. One goat was observed in Ramsey Creek during this study.

The north half of the West Cabinets, from approximately Drift and Twin Peaks northward today has few goats, but prior to 1960 they were common. J. Cox (personal communication) tells of regularly seeing mountain goats in Cheer Creek, Benning Creek and West Fork of Keeler Creek and J. Dillon (personal communication) indicated that goats were commonly observed in Drift Creek when that drainage was first roaded. In 12 observation flights over Keeler Creek and its tributaries one goat was spotted in Cheer Creek and on two occasions one goat was seen in Drift Creek. When logging operations were underway in Surprise Draw along lower Keeler Creek, L. Emry (personal communication) related instances of workmen tossing bits of lunch to goats which frequented the area. These goats were actually not far from cliff terrain further up the draw, but they were observed in timbered country, which was considered very unusual. No goats are reported to have been seen in this vicinity since the initial logging operation. Further to the north on Smith Mountain, Emry related seeing a female and kid on the north side of the mountain in early July over 20 years ago. Occasional observations from the Smith Mountain area are still reported. As recently as fall 1979 a hunter saw two goats on Smith Mountain near the old look-out. R. Rogers (personal communication) and L. Gissel (personal communication) provided distribution and past information about the Idaho portion of the Cabinet Mountains from Lightning Creek east to the Montana border. Gissel felt that the area's population had remained relatively stable without significant changes in distribution. In the northern portion around Gem Lake, Moose Lake and Lake Estelle a few goats summer but he felt they moved down along Lightning Creek to Char Creek to winter. He sited four possible winter areas, capable of supporting a few goats including: Char Creek along the East Fork of Lightning Creek, Scotchman No. 2's south face along Sam Morris Creek up to 7,000 feet, Savage

Peak's south bluffs and West Fork of Blue Creek. During this study goats were observed wintering along West Fork of Blue Creek and Savage Peak. While no goats were observed wintering along Char Creek or Morris Creek both areas were identified as likely winter range (Map 2) and goats were observed wintering along Thunder Creek, just east of Char Creek.

Outlying observations of goats which may represent travel routes or remnants of a once larger extension of the Cabinet Mountains population were provided by B. Robinson (personal communication). Robinson reported that B. Miller (an employee of the Forest Service) saw a mountain goat during the spring along Highway 200 near Cabinet Gorge. When sick, injured or senile, goats are known to wander out of typical mountain goat country (Rideout 1974), but male goats are also known to travel between mountain ranges. Chadwick (1973) describes goats crossing the South Fork of the Flathead River moving from the Swan Range toward the Continental Divide, and Singer (1975) watched goats regularly cross the Middle Fork of the Flathead. It is not out of the realm of reason that the goat observed along the Clark Fork was moving south into the Bitterroot Range. Goats were occasionally observed south of the Clark Fork River (Casebeer et al. 1950) until the late 1940's. Robinson related an observation in Martin Creek as recently as 1973 of a single goat, and another in Green Gulch. B. Henderson (personal communication) indicates that two hunters observed a large goat along Martin Creek during 1980.

Relative Population Levels

Past

Historical mountain goat population levels and trends are not well understood because past information was not based on systematic inventories. Past information does suggest that the population has been declining over the past 30 to 50 years (Casebeer et al. 1950). "There is often a tendency to estimate goats on the basis of the amount of typical range that is seen rather than on actual counts of animals" (Brandborg 1955) but actual counts are often not possible in heavily vegetated mountainous country and "estimates are subject to variation with changes in personnel making the reports" (Casebeer et al. 1950). The Forest Service began estimating goat numbers in 1919 and continued until 1942. The 1919, 1920 and 1921 estimates went from 250 up to 445 down to 100. These dramatic fluctuations in estimates continued for 24 years when the last estimate was 240 animals. During this 2½ decade period the estimate was less than 200 goats during 8 years and over 300 during 2 years.

Based on cursory field examination and information from reliable sources, Casebeer et al. (1950) settled on an estimate of 305 mountain goats in the East Cabinets and 45 in the West Cabinets. In Idaho's Ligtning Creek portion of the West Cabinet Mountains, Brandborg (1955) estimated that herd size, based on other observers data, at 25 animals. R. Rogers (personal communication) said that during a 1969 helicopter survey of this area two groups of goats each containing six to nine animals

were observed. L. Gissel (personal communication) felt that the size of this herd had remained fairly stable. Herd declines have occurred in the West Cabinet Mountains at least on the Montana side of the border where roads have penetrated mountain goat habitat. No regular survey information has been collected on the Idaho portion of the range however, (R. Rogers, personal communication) so we may not be aware of all past areas of goat use or of the influences of the Ligtning Creek road on mountain goats occurring near it.

In the portion of the southern Cabinet Mountains where Burleigh (1978) studied, the herd was estimated in the 1930's at 110 (Forest Service records) but it had steadily declined to 25 or less by 1978. Casebeer et al. (1950) cite Forest Service personnel observing 75 goats in the North Fork of the Bull River. During the current study on only two of six aerial surveys were more than 75 animals observed throughout the entire Cabinet Mountains Range.

Present

From May 1979 through June 1980, 165 mountain goat observations were made from the ground (Table 1) while 315 were made from the air (Table 2) with 97 unduplicated observations made during one survey. A minimum population estimate is based on the survey of 97 animals. It is believed that up to 40 percent of the population may have been overlooked during this June 1980 survey yielding a maximum population of 161 mountain goats in the East and West Cabinet Mountains. Table 2 provides the number of goats observed and the classification breakdown for six flights conducted over the study area. The two highest survey counts occurred in June 1979 and June 1980 just after a new kid crop was added to the population, which undoubtedly upwardly biased the estimate of the population. A population estimate based on June data may overestimate the population, but the June 1980 flight was the best of six. The estimated maximum population of approximately 160 animals is reasonable (although possibly high) when analyzing the other survey flight totals. The entire range was completely surveyed during May and June 1979 without severe complications from weather. If the population was approximately 160 animals, then only 29 percent of the population was observed during May and 49 percent was observed during June 1979, but more than the stated percentages were probably observed, thus making the population estimate of 160, high.

Every effort was made to make flights comparable but weather constraints affected the November and February surveys. The July 1979 flight was conducted with a fixed-wing aircraft rather than a helicopter which is blamed for the poor results that month. Nevertheless, the data collected during this study is the most comprehensive ever collected on mountain goats in the Cabinet Mountains. Aerial surveys in the Cabinet Mountains are best done during late June for the following reasons: 1) the weather is more reliable than during other periods, 2) that year's kid crop is visible, 3) yearling recruitment is most easily determined, 4) goats are in large observable groups. Winter surveys are particularly difficult for the following reasons: 1) weather is very poor for flying, 2) observing white goats in a

Table 1. Classification of mountain goat observations obtained during ground reconnaissance.

	West Cabinets							East Cabinets							Total						
	Total	Ad. M.	Ad. F.	Adult	Subad.	Kid	Unkn	Total	Ad. M.	Ad. F.	Adult	Subad.	Kid	Unkn	Total	Ad. M.	Ad. F.	Adult	Subad.	Kid	Unkn
May 1979								7				1		6	7				1		6
June 1979	21		2	9	4	6		1						1	22		2	9	4	6	1
July 1979	11		1	6	1		3	7			5	2			18		1	11	3		3
August 1979	1			1				37			31	2	4		38			32	2	4	
Sept 1979	5			4			1	20		5	7	2	4	2	25		5	11	2	4	3
Oct 1979	4			3	1										4			3	1		
Nov 1979	1			1											1			1			
Feb 1980	9		2	3	2	2									9		2	3	2	2	
Apr 1980	6			5		1		11			8		3		17			13		4	
May 1980	1			1				23			15	4	4		24			16	4	4	

Table 2. Classification of mountain goat observations obtained during six aerial surveys, 1979 and 1980.

Date	West Cabinets							East Cabinets							Total						
	Total	Ad. M.	Ad. F.	Adult	Subad.	Kid	Unkn	Total	Ad. M.	Ad. F.	Adult	Subad.	Kid	Unkn	Total	Ad. M.	Ad. F.	Adult	Subad.	Kid	Unkn
May 3-4	10		3	3	1	3		36	2	2	17	7	6	2	46	2	5	20	8	9	2
June 11-12	23		4	12	2	4	1	55		7	26	12	9	1	78		11	38	14	13	2
July 21-23	7		2	4		1		15		3	6	3	3		22		5	10	3	4	
Nov 15, Dec 11[1/]	20	3	3	8	2	3	1	22	1	8	7	4	2		42	4	11	15	6	5	1
Feb 17, 21, 22	11	2	2	3	3	1		19		4	10	2	3		30	2	6	13	5	4	
June 24-25	41		12	8	7	10	4	56		17	12	5	16	6	97		29	20	12	26	10

1 Incomplete survey.

white landscape is difficult, 3) tracks quickly disappear in drifting and melting snows and are not discernible from deer tracks at a distance, 4) goats tend to move very little in winter - seeking shelter in caves, under overhangs or beneath thick canopy cover.

A total of 753 mountain goat observations were recorded from April 1977 to June 1980 including 129 singles and 153 groups composed of two or more goats.The largest groups were seen during June and July (13, 11, 9, 9, 9). During summer the average summer group size was 4.5 animals. The average group size ranged from the high summer figure to a low of 3.5 during fall, with spring having 4.0 and winter 4.3. The greatest percentage of single animals was seen during winter when 24.6 percent of all observations were lone goats. This may have been a reflection of being able to spot tracks and follow them to their source but the trend is in keeping with social pressures during winter as described by Smith (1976). The smallest percentage of single animals occurred during fall when only 11.7 percent of the observations were singles suggesting that goats were grouped on breeding grounds. During summer 20.8 percent were single goats and during spring 15.2 percent were singles. As compared to drier windswept ranges, winter group size appear to be smaller on ranges receiving heavy wet snows which dictate use of steep cliffs with good snow shedding abilities.

Table 2 shows that there were few confirmed sightings of males, but the unclassified adult and unclassified goat component undoubtedly included males. Most researchers have found that the sex ratio is skewed to females. Rideout (1974) found a ratio of 24 to 44 males per 100 females in the Sapphire Mountains while Chadwick (1973) in the Swan Range indicated that 1/2 to 1/3 as many adult males existed as adult females. During surveys of the Cabinet Mountains solitary adult males were likely overlooked more often than females, but this oversight because of comparatively low numbers of males, is not likely to significantly bias the population estimate.

Once a population estimate is calculated, whether accurate or not, the tendency is to extrapolate this figure to a density estimate. Density, of course, must be described in terms of area. The most common density figures given are for winter range, but normal population fluctuations and winter severity influence this figure. Realistic density figures should be based on data from several animals' year long range which can only be calculated through intensive radio monitoring techniques. This information was not available for the Cabinet Mountains population.

Probably more important than determining the density of a population at one point in time,is obtaining an insight into population fluctuations over time. In order to monitor and interpret population fluctuations, surveys must be duplicated in a given area with a consistent level of sex and age classification accuracy over a series of years. Age and sex ratios have been purported to provide insight into a population's well-being but Caughley (1974) points out that a high young to adult ratio which supposedly reflects a healthy reproducing population has in fact occurred in herds which are crashing to extinction. On the other hand a low young to adult ratio may not necessarily indicate a declining

herd, on the contrary, it may indicate a stable even increasing healthy herd. While Caughley (1974) explains that regular censusing makes sex and age ratio interpretation needless, in the heavily timbered Cabinet Mountains where actual counts are difficult to achieve, regular censuses together with ratio interpretations can give valuable insight into population trends. Pac (1980) points out in the case of deer, traditional interpretations of a herd's age structure have failed to recognize different types of population dynamics and he postulates that geographic location in association with climate may predetermine the population dynamics of a species in a given location. Considering the variety of climates and terrains which mountain goats inhabit across their North American range, it would seem logical that population dynamics scenarios would change from place to place and thus population management goals could not be established for one area with information gathered from another - as is sometimes done.

If the nature of the Cabinet Mountains habitat can be generalized, it could be described as having a predictable summer climate and high quality subalpine summer range, while the winter climate is severe. Pac (1980) postulates for deer that a habitat regime of this nature would set the stage for a herd having an old age structure and variable recruitment. If an old age structure is the case for the Cabinet Mountains goats, and that structure is determined by environmental conditions, losses to the adult segment through human intervention can have immediate and long term effects on the herd. Such a population alteration could be masked if an age ratio figure (without having regular census information) were used since a reduction in adults may increase the young to adult ratio. Herd losses in the Cabinets seem to be most easily explained by the hypothesis of an age structure skewed toward older animals as a result of environmental conditions. If this is the case, careful management will be required since there is little room for error.

Habitat Use

The way in which a mountain goat uses it range can be understood only through intensive study which was not possible during this general investigation. Environmental information collected at each observation location, however, provides some indication of relative seasonal use of the range. Since ground sampling of the study area was not systematic, only comprehensive seasonal aerial surveys were used in the analysis of habitat utilization.

Seasons were divided into 3 month increments to approximate life-cycle phases of the mountain goat: spring (April, May, June), summer (July, August, September), fall (October, November, December), winter (January, February, March). Spring is the period during which goats begin to disperse from winter range and young are born. Summer reflects use of high elevation summer ranges, coalition of nursery groups, then group dispersal in response to vegetation desiccation. Fall brings the first snows and signals a return to winter range and the breeding season. Winter is spent snowbound on winter ranges.

Tables 3, 4 and 5 present data collected on 316 mountain goats observations made during six aerial surveys.

Table 3. Percentage of mountain goat observations recorded in each category of cover type, terrain type and distance from escape terrain, timber and roads.

Cover Type[1]		Timber	Shrub	Grass/Forb	Rock/Bare
May	(47)[2]	83.0	6.4	51.1	14.9
June	(78)	73.1	20.5	50.0	26.9
July	(22)	18.1	9.0	59.1	27.3
Nov	(42)	45.2	7.1		69.0
Feb	(30)	63.3	33.3	1.0	63.3
June	(97)	64.9	20.6	27.8	34.0

Terrain Type[1]	Bluffs	Cliffs	Talus	Broken	Ridge	Park	Sidehill
May	44.7	48.9		6.4			
June	16.7	59.0	19.2	37.2	7.7		
July	4.6	13.6		18.2	9.0	45.6	9.0
Nov	42.9	50.0	2.3	4.8			
Feb	56.7	66.7	20.0				3.3
June	61.9	15.5	13.4	27.8	4.1	5.1	1.0

Distance Escape (ft.)	30	30-150	150-300	300
May	97.9		2.1	
June	98.9	1.3		
July	45.5		9.0	45.5
Nov	92.8			7.2
Feb	76.7	23.3		
June	64.9	17.5	17.6	

Distance Timber (ft.)	<30	30-150	150-300	300
May	63.8	8.5	23.4	4.3
June	76.9	10.3	9.0	3.8
July	77.3	9.0		13.7
Nov	57.2		19.0	23.8
Feb	66.7	13.3	20.0	
June	70.1	22.7	7.2	

Distance Road (mi.)	<0.25	0.25-0.5	0.5-1.0	1.0
May	2.1			97.9
June			5.1	94.9
July				100.0
Nov				100.0
Feb	6.7		3.3	90.0
June			1.0	99.0

1/ An observation may have occurred in more than one terrain or cover type so the total may not equal 100.

2/ Number of goats observed during flight

Table 4. Percentage of mountain goat observations recorded on each of eight aspects during six aerial surveys.

West Cabinets/East Cabinets

May		-/5.4	80.0/2.7	10.0/2.7	-/56.8	-/32.4		10.0/-	10/37
June	-/16.4		8.3/25.5	-/36.4	-/ 5.4	13.0/-	43.4/14.5	39.1/1.8	23/55
July	14.3/-			8.6/6.7		-/6.7		57.1/86.6	7/15
November		5.0/-		-/59.1	15.0/40.9	10.0/-		70.0/-	20/22
February		9.1/-	36.4/-	18.2/26.3	27.3/73.7	9.1/-			11/19
June	2.4/-	-/16.1	26.8/50.0	2.4/10.8	19.5/8.9	14.6/7.1	24.5/-	9.8/7.1	41/56

Cabinet Mountains - Composite Total

	N	NE	E	SE	S	SW	W	NW	No. Observed
May		4.3	19.1	4.3	44.7	25.5		2.1	47
June	11.5	19.2	25.7	3.8	3.8	23.2		12.8	78
July	4.5			13.6		4.5		77.4	22
November		2.3		31.0	28.6	4.8	33.3		42
February		3.3	13.3	23.3	56.7	3.4			30
June	1.0	9.4	40.2	7.2	12.4	10.3	10.3	8.2	97

Table 5. Elevations at which mountain goats were observed during six aerial surveys of the Cabinet Mountains, 1979-1980.

Elevation in Hundreds of Feet	EAST CABINET MOUNTAINS					
	May (37)[1/]	June (55)	July (15)	November (22)	February (19)	June (56)
38-42						2
43-46				13	5	
47-50					26	7
51-54	11	3				27
55-58	5	2		14	11	3
59-62	30	9		41		2
63-66	51	4	80	32		45
67-70	3	62	20		26	14
71-74		13			32	
75-78		7				
	WEST CABINET MOUNTAINS					
	May (1)	June (23)	July (7)	November (20)	February (10)	June (41)
34-39						2
38-42	50	39		5	36	10
43-46	50	4	28	15	46	2
47-50				10	18	44
51-54		13	29	65		10
55-58		9		10		15
59-62		35				17
63-66			43			
67-70						
71-74						

1 Number in parentheses indicates number of mountain goats observed.

Cover Types

More than one cover type was often recorded for a single observation if different overstory layers occurred in mosaic fashion or if the tallest overstory layer was particularly sparse (Table 3). During winter and spring goats were observed in the timber cover type most often while the grass/forb cover type was important in the spring and summer and the rock/bare ground type received its greatest use during fall and winter. The rock cover type is so described because from the air no vegetation was discernible, however, ground checks at locations described as rock from the air revealed grasses and forbs and mat-forming shrubs along ledges and in crevices. In local areas this type was exposed from wind action or solar radiation. The grass/forb or rock cover types ranked second in overall use behind timber during all seasons. The shrub cover type reached its greatest use during winter when the grass/forb and rock/bare ground cover type were under snow.

Different cover types have different capabilities to provide security, forage and thermal insulation. On the British Columbia coast mature timber provides essential mountain goat habitat (Hebert and Turnbull 1977). Timber is used by goats for security cover, as is the shrub type when it is of sufficient height to conceal a goat. Aerial predator attacks on goats (eagles) and aerial harassment by man are thwarted when goats take refuge in timber, and during aerial surveys goats consistently took refuge under trees. The forage value of each cover type is contingent upon the season. A discussion of food habits was given previously but in terms of cover types, when green grass and forbs are available the grass/forb cover type is heavily used. When either desiccation or snow renders grasses and forbs undesirable or unavailable the shrub cover assumes greater importance. Although the observed use of the timber cover type ranked first during fall, winter and spring this may be accounted for by the ubiquitous distribution of timber over the study area; but conifers do provide limited forage for goats during all seasons.

Ground observations and radio telemetry information from one instrumented animal indicate that the timber and shrub cover types are used to a much greater degree than aerial observations would suggest. Rideout (1977) noted the same during a telemetry study of mountain goats in the Sapphire Mountains of southwest Montana.

Habitat Types

Mountain goat summer range generally occurs in the *Abies lasiocarpa* series, while most winter ranges occur within the *Pseudotsuga menziesii* series. Occasional observations were made in TSHE/CLUN, THPL/CLUN and *Picea* (spruce) habitat types. While an understanding of habitat types and a knowledge of their distribution on the study area help in describing the topographic, soil and climatic features of an area they are not as useful as cover types in describing the current general vegetative condition of a site. Interspersion of various cover types over an area is likely more important to mountain goats than the ultimate climax habitat

type since a number of habitat types may have essentially equal cover and forage characteristics at some time during their development.

Terrain Types

More than one terrain type may have been recorded for each observation if there was a group of animals using more than one type or distributed over an area having more than one type. Cliff and bluff terrain types provided the most secure escape terrain and were the most important of the eight described types during all seasons except summer (Table 3). While the sample size for the summer (July) flight was undesirably low (22 animals), the observations did show use of terrain types which do not afford security. Groups were regularly observed in atypical goat terrain during late June and July, feeding in meadows or along creeks some distance from escape terrain. Other investigators have observed that goats use atypical goat terrain during summer. The park type accounted for 45 percent of the summer aerial observations and the sidehill type received its greatest seasonal use during summer. All animals observed from the air in these types were nursery groups. A tally of ground observations for the summer season showed the following use of terrain types: sidehill (47), creekbottom (17), talus (11), broken (11), cliff (10), bluff (10), ridge (7) and park (2).

Aspect

Use of aspect by mountain goats appears to be determined by season. Table 4 shows the percentage of observations noted on eight aspects during six aerial surveys of both the East and West Cabinet Mountains. Figure 2 compares observed seasonal use of aspect by mountain goats from 1977 to 1980. The 1977 and 1978 observations (Joslin 1980) were made in the West Cabinets only but this sampling difference does not appear to have biased the comparison. A theoretical cone-shaped mountain can be divided into four general aspects, each spanning 90 degrees. If seasonal goat distribution had been random and all aspects were equally represented on the study area, then for example, 25 percent of the observations would have been noted on east aspects (NE, E and SE). Taking into account observability constraints on certain aspects (timbered north slopes) and the fact that the relative occurrence of each aspect on the study area was undetermined we may still assume that if goats were randomly distributed there would be no observed difference in use of aspect between seasons, but there was an apparent seasonal selection of aspect.

One or two general directions (25-50 percent of the aspect spectrum) are predominantly used during each season. From 69 to 80 percent of the spring observations were noted on east and south aspects (1977 - 69 percent, 1978 - 84 percent, 1980 - 80 percent) reflecting selection for low snow packs and early vegetation green-up. North aspects were used during summer (1977 - 65 percent, 1978 - 67 percent, 1979 - 82 percent), probably indicating use of cool microsites for thermal regulation and selection for succulent vegetation. West and south aspects received the majority of fall use (1977 - 85 percent and 1979 - 98 percent) probably because the vegetation on cooler aspects would have been frosted by this time and because the first snows would have signaled the fall migration to winter range. Similar to spring, east

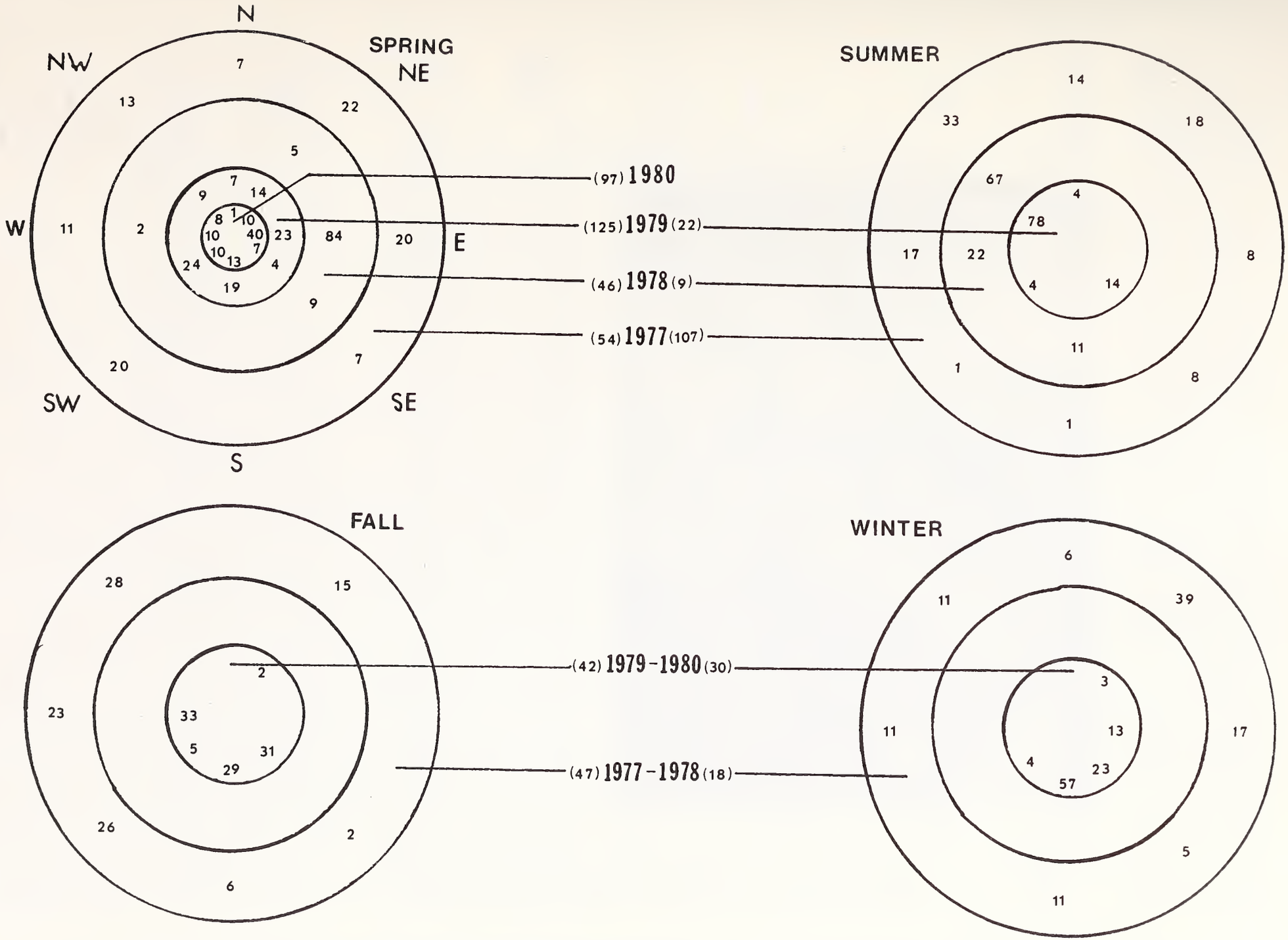


Figure 2. Yearly comparison of observed seasonal use of aspect by mountain goats in percent. (Numbers in parentheses are the number of mountain goats observed).

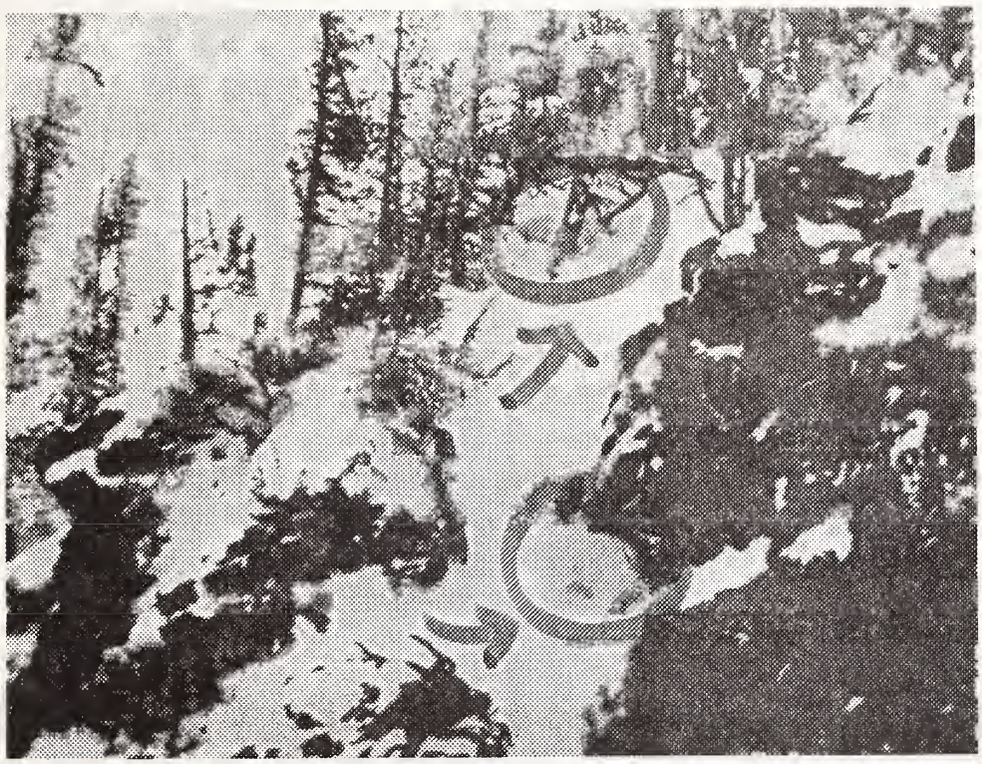
and south aspects received the majority of winter use (1977 - 72 percent and 1979 - 100 percent). It was felt that west aspects are used to a greater extent during both winter and spring than the data indicate since 13 of 65 winter range sites (20 percent) occurred on west aspects; however the westerly winter ranges were not completely inventoried during the winter and spring surveys due to poor flying conditions.

Known seasonal use of aspect will be of use to managers in scheduling human activities in mountain goat habitat to avoid conflict during seasonal use periods.

Elevation

Mountain goat terrain in the East Cabinet ranges from about 3,800 feet to 8,700 feet while in the West Cabinets the elevation spread is from 2,800 feet to 6,900 feet. Using winter range sample sites as a comparison between differences in elevation between the East and West Cabinets, the east face of the East Cabinets averages about 780 feet higher than West Cabinet sites while those of the West face of the West Cabinets average about 150 feet higher. During all surveys, mountain goats were observed at higher elevations in the East than in the West Cabinets. This difference was a function of suitable terrain being distributed at higher elevations in the East as compared to the West Cabinets. The lower elevation terrain of the West Cabinets tends to predispose goat habitat to road systems which are a function of greater timber harvest due to the higher growing potential of the area (lower elevations and greater moisture regime). Table 5 presents all observations from the East and West according to elevation class. During May, 100 percent of the observations in the East Cabinets were above 5,000 feet while 100 percent of the observations in the West Cabinets were below 4,700 feet. The next 5 surveys followed the same trend: June = 82 percent above 6,600 feet in the East Cabinets (E.), 100 percent below 6,300 feet in the West Cabinets (W.); July = 100 percent above 6,200 feet (E.), over 50 percent below 5,500 feet (W.); November = 87 percent at or above 5,500 feet (E.); 90 percent below 5,500 feet (W.); February = 69 percent at or above 5,100 feet (E.), 100 percent below 5,100 feet (W.); June = 91 percent at or above 5,100 feet (E.), 58 percent below 5,100 feet (W.).

Alpine vegetation from the onset of green-up to the first frost provides more nutritional value per unit forage than low elevation plant species (Johnston et al. 1968). The East Cabinets because of its larger area and higher elevation country and thus more alpine vegetation most likely provides more nutritional value per unit area than the West Cabinets. It would seem that the elevational advantage during the growing season would be offset by deeper snow accumulations which must be contended with on winter ranges. However, approximately two-thirds of the East Cabinets occur in lighter snowfall zones than the West Cabinets (a possible rain shadow effect), so the disadvantage of higher elevation winter terrain may be partially compensated. Focus should be placed on winter range because of its very limited nature. Seasonal elevational movements of goats are reflected in Table 4 which, for the West Cabinets, indicate the expected: that goats are at low elevations in spring, they move up in late spring and summer and they move down in fall and winter. In the East Cabinets the pattern is less distinct and



Mountain goats observed in the Deep Creek drainage at 7,300 feet during winter.

and in fact is disrupted during winter when a large percentage of observed goats occurred at high elevations. The observations of goats in Camp Creek at 6,800 feet can be explained by the lack of snow on the southerly protected slope. But the group observed in Deep Creek at 7,300 feet is less easily explained since there were more suitable sites elsewhere and these animals were observed laboring in deep snow. Temperature inversions may play a part in goat use of higher elevations and/or upper elevation snow characteristics may facilitate forage availability as opposed to heavy crusted snow at lower elevations. In general, higher sites will be used during warm months and lower sites during cold months. Mountain goats do not select sites on the basis of elevation alone but do so in conjunction with aspect and topography which together provide seasonal comfort, security and nutritional needs.

Distance to Escape Terrain

During all surveys except July 80 percent or more of the goats were 150 feet or less from escape terrain (Table 3). Results of the July survey seem to be inconsistent with other surveys in that 55 percent were 150 feet or more from escape terrain, but only 22 goats were observed during this survey and half of these were a nursery group observed in a meadow along a creekbottom. The late June 1980 survey revealed that 17 percent of the 97 goats observed were as much as 300 feet from escape terrain. The majority of the June and July animals were nannies and kids, suggesting that during the post-partum period mountain goats will venture longer distances from escape terrain to obtain prime forage in an effort to recover from nutritional stress brought on by the combined effects of winter, pregnancy, parturition and lactation.

Distance from Timber

While timber may or may not be an integral part of mountain goat habitats throughout North America, in the Cabinet Mountains timber is the rule, even in rocky high elevation terrain types. It became apparent, particularly during helicopter surverys, that timber provided security to goats from aerial intrusion. It was not determined whether timber occurring over 300 feet from rocky escape terrain provided security to goats since it was difficult to sample heavily forested areas. It was felt that the combination of timber on rocky escape terrain provided maximum security but this may have been a function of the Cabinet Mountains environment rather than a preference of mountain goats. In any case, during all surveys at least 57 percent of observed goats were within 30 feet of timber (range 57 to 77 percent). During all but the February survey, some animals were observed over 300 feet from timber. The fact that goats were consistently near timber during the winter survey supports the likelihood that timber is important for snow intercept and is therefore sought by goats during seasons of deep snow accumulation. Timber is also utilized as winter browse and provides lichen as a food source.

Distance from Nearest Drivable Road

Mountain goats were rarely observed closer than 1 mile to the nearest drivable road. The fact that goats were not seen closer to roads may not have been so much an avoidance behavior by goats as it is that goat habitat is generally not suitable for road building. However the West Cabinet goat range has been more influenced from road systems than the East Cabinets since that side of the range tends to have less topographic relief. During winter and spring a few goats were observed as close as ¼ mile from a road. This is a result of use of low elevation winter ranges which are often visible from roads.

Mountain Goat Transplant

In an effort to recolonize the north half of the West Cabinets with mountain goats the Montana Department of Fish, Wildlife and Parks and the Washington Department of Game and Fish entered into a

cooperative agreement to exchange mountain goats from Washington for bighorn sheep from Montana. On June 28, 1980, seven mountain goats including: 8-9 year old female, 3-year old female, 4-year old female with a male kid, 3-year old female with a male kid, and yearling male, were released in Drift Creek. Four radio trnasmitter collars were fitted on the 3 young females and yearling male, a colored collar was placed on the old female and all animals were ear tagged. To date, the 3-year old female without a kid died shortly after release, the 4-year old female moved south to Pellick Ridge where she appears to have taken up residence, the male and 3-year old female (status of her kid unknown) have made wide ranging movements but are in the vicinity of Keeler Creek. The old female was reported by hunters to be in the creekbottom along Ross Creek above the Ross Creek Cedar Grove. Monitoring of the radio-marked goats is continuing.

Radio-collared mountain goat released in the Drift Creek Drainage, July, 1980.

The success of this transplant will be determined in 1981 and future years when ground reconnaissance reveals whether the 2 radio marked females have born offspring and are frequenting the north half of the West Cabinet Mountains where it was hoped they would establish.

Food Habits

Goats traveled through timber and away from escape terrain to visit a lick site on the mining road on the south side of Mount Vernon. Rideout (1974) noted that goats will travel some distance from escape terrain to obtain salt and he hypothesized that the increased risk of predation must be offset by the drive and need for salt. Hebert (1967) noted that goats will find lick sites remarkably quickly. Whether the lick on the Ross Creek side of Mount Vernon is a natural or artificial one was not determined, however, a mineral exploration drill hole was the center of the lick so drilling compounds may have developed an artificial mineral source. During the trapping-marking program a salt block was placed on top of Mount Vernon and another on the Mount Vernon-Spar Peak ridge. In addition to being trap bait the blocks were intended to keep goats away from the road. Both sites were soon discovered and used by all species of local ungulates. The Mount Vernon site is thought to receive some use by mountain goats during all snow-free months. Winter use may occur at the site as well, since lick use has been noted during winter by DeBock (1970). The majority of lick use was recorded at the site during June.

In the Cabinet Mountains an intensive seasonal food habits study has not been conducted although fresh pellet groups were collected during each season and were analyzed for food item identification according to procedures outlined by Todd and Hansen (1973). During all months shrubs dominated the diet with *Vaccinium* spp., *Symphoricarpos albus*, *Ceanothus* and *Rubus* the species primarily used (Table 6). Not all samples were taken from the same area. May, June, July, August and September samples were collected on Mount Vernon while the early and late winter and March-April samples were collected from Wiggletail Creek. These sites differed in that the Mount Vernon area was a timbered east exposure while the Wiggletail area was on a southerly open slope. *Vaccinium* was the primary shrub used from the Mount Vernon area while *Ceanothus* was the primary shrub used in the Wiggletail area. Grasses or grass-like plants were second in importance during all sample periods except July when grasses equalled shrubs in the diet and early and later winter when trees were second to shrubs in forage volume intake. *Carex*, *Agropyron spicatum*, *Festuca* and *Bromus* were the most abundant grasses in the diet. During each sample period at least some use of trees was noted. *Pseudotsuga* received the greatest use, particularly during winter followed by minor amounts of *Pinus*. *Thuja plicata* was detected in minor quantities in the early winter sample. Forbs composed 1 percent or less of the diet during all sample periods. It would seem that forbs should have been a more important component of the spring and early summer diets since forbs are known to be highly sought after by goats during this time of year. Difficulty in discerning certain fragile or soft tissue plant species may account for the apparent lack of forbs in the diet (Todd and Hanson 1973). Lichens appear in the diet during fall. Harmon (1944), Hanson (1950), Brandborg (1955) and Chadwick (1973) indicate that lichens compose an important portion of the winter diet and D. Hebert (personal communication) suggests that the nutritional value of lichens may be quite high due to the lack of nondigestible lignified cellular material.

Table 6. Percent relative density of vegetation in mountain goat fecal samples[1] collected during 1979 and 1980.

	June[2]	July	Aug	Sept	Nov	Early WNT 1980	Late WNT 1980	Mar-Apr	May
TREES	(0.23)[3]	(0.42)	(1.00)	(0.31)	(0.32)	(27.81)	(13.44)	(4.28)	(1.58)
Pinus		0.42	1.00		0.32			0.32	
Pseudotsuga	0.23			0.31	0.64	27.19	13.44	3.96	1.58
Thuja plicata						0.62			
SHRUBS	(83.48)	(49.08)	(76.96)	(94.43)	(48.83)	(63.88)	(75.94)	(53.83)	(71.24)
Amelanchier alnifolia	3.10	0.42							0.31
Berberis repens						7.15	7.75	1.95	0.31
Ceanothus						48.01	61.03	13.09	
Juniperus						1.66		0.97	
Potentilla		1.69			0.32				
Prunus			0.33	0.62		0.20			
Rubus	2.61			21.96	3.94				
Salix	5.89							0.32	
Spirea	0.23					0.20			
Symphoricarpos albus	56.22	4.29	3.39	7.52	2.26				0.31
Taxus	1.87				1.94			5.34	0.31
Vaccinium	13.56	42.68	73.24	64.60	40.37	6.66	7.16	32.16	70.00
FORBS	(0.23)	(0.84)	(1.00)	(0.93)	(0.32)	(-)	(-)	(0.97)	(0.31)
Achillea millefolium	0.23								
Compositae			1.00	0.31					
Delphinium		0.84		0.31					
Draba					0.32				
Plantago (type)								0.97	
Unknown forb				0.31					0.31
GRASS etc.	(16.06)	(49.66)	(21.04)	(4.06)	(39.97)	(8.31)	(10.62)	(40.27)	(26.87)
Agropyron spicatum	6.15	1.69	1.33	1.88	24.52	2.32	0.78	6.39	11.99
Agrostis scabra		2.55							0.94
Bromus	6.42	3.84	2.02	0.31	2.26	1.25	2.09	9.65	3.86
Calamagrostis					6.34				0.31
Carex	1.40	26.87	8.82		4.27	4.54	5.13	12.31	6.57
Danthonia	0.93						0.26		
Festuca	0.93	12.60	4.80	1.56	5.30		2.36	11.92	3.20
Juncus		2.11	0.33						

Table 6 continued. Percent relative density of vegetation in mountain goat fecal samples[1/] collected during 1979 and 1980.

	June[2/]	July	Aug	Sept	Nov	Early WNT 1980	Late WNT 1980	Mar-Apr	May
Luzula			3.74	0.31					
Poa	0.23				0.64				
Stipa					1.94	0.20			
Lichens	(-)	(-)	(-)	(-)	(4.62)	(-)	(-)	(0.65)	(-)

1 A sample was composed of subsamples of five pellet groups totalling 1 gram.
2 June, July, August, September, November and May samples were collected from Mount Vernon. Early winter, late winter and March-April samples were collected from the Wiggletail Creek drainage.
3 Numbers in parentheses are total percentages for each forage category.

A comprehensive mountain goat food habits analysis was conducted by Chadwick (1973) in the Swan Range, which lies roughly 100 air miles east of the Cabinet Mountains. Vegetation of both ranges are similar, therefore the results of Chadwick's work is likely applicable to the Cabinets study area. This information is presented in Appendix 3 with emphasis upon vegetation species known to occur in the Cabinet Mountains. These data will provide an important future starting point from which to investigate Cabinet Mountains mountain goat food habits.

In determining average crude protein levels of 15 goat winter forage plants from the Bitterroot Mountains, Isdahl (1976) found the value to be 6.97 percent. No minimum crude protein requirements are known for mountain goats but Hebert (1973) established body maintenance levels in bighorn sheep at 6 to 7 percent while Dietz (1965) found the same for deer. Fourteen of 15 plant species tested (Isdahl 1976), occurred on sampled mountain goat use sites (Appendix 4) in the Cabinet Mountains, so her information would seem to be applicable to the Cabinets. Food habits data collected in the Bitterroot Mountains by Smith (1976) indicate that grasses were the primary winter food source in the Bitterroot study area, however, while shrubs were the primary winter food source in the Cabinet Mountains. Comparable testing would be necessary to determine the crude protein values of major winter range forage species for the Cabinet Mountains and it would be desirable to assess blood chemistry features of the goats as well.

As with most ungulate species, mountain goats use winter ranges which allow minimum energy expenditure in obtaining maintenance forage. Late winter and early spring is the peak stress period, but it is summer range with its available and highly nutritious forage which fortifies the body for winter. More must be learned about the nutritional balance and needs of mountain goats while ensuring that they get full use of summer ranges and absolute minimum disturbance on winter ranges.

Seasonal Ranges

It was not determined whether discrete herds exist in the Cabinet Mountains or whether intermingling between concentration areas is the norm. Brandborg (1955) commented that two-thirds of Idaho's mountain goat population occurred in herds of 50 animals or less and flight data from the Cabinets suggests that the same is true for this area. The East Cabinet Mountains differs in habitat configuration from the West Cabinet Mountains in that it is linear, resulting in three major goat concentration areas, each having its own winter and summer ranges (1. Camp, Porcupine, Twin, Falls, Cedar, Parmenter and Flower creeks; 2. North, Middle and South Forks of the Bull River, Granite, Deep, Snowshoe, Cherry, Ramsey, Bear, Poorman and Cable creeks; 3. Libby, West Fisher, Geiger, Swamp, Rock creeks and East Fork Bull River). The West Cabinets have a more circular configuration with winter ranges occurring around the periphery and summer range in the center (Ross, Blue, Savage and Spar creeks). If human activities were to occur in the heart of the West Cabinet Mountains they could have serious consequences for West Cabinet Mountain goats since goats which winter miles apart move to a common summer range at the heads of Ross and Spar creeks. The same human activity executed in the East Cabinet Mountains could affect discrete concentration

areas. It is important to determine whether interchange between areas occurs.

Map 2 was derived by plotting mountain goat observations made during six aerial surveys conducted during May, June, July and November-December 1979 and February and June 1980 (Table 2) and ground observations (Table 1) by the Montana Department of Fish, Wildlife and Parks personnel and other reliable observers. Mapped locations of rock terrain types discerned from infrared aerial photographs and 1:24,000 topographic maps supplemented the investigator's familiarity with the study area in outlining mountain goat seasonal habitat.

The heavy exterior line defining the study area in Map 2 (pocket map in back flap) broadly outlines mountain goat habitat in the Cabinet Mountains of Montana and a portion of Idaho. Mountain goat habitat is not continuous within this boundary but the dendritic pattern of seasonal mountain goat terrain and the fact that goats occasionally move from point to point rather than follow a more circuitous ridge-top route, suggests that the habitat boundary be drawn by the 3,000 foot level or higher depending upon terrain. The area within this boundary, unless otherwise defined is designated as 3 in Map 2 for management reference.

Winter Range

Sites which appeared to be suitable winter range but at which no observations were made, were delineated on the basis of terrain type, elevation, aspect and slope; data applied to a precipitation equation (Appendix 2) provided mean maximum snow depth indexes. Table 7 provides these data for 65 sites in the Cabinet Mountains, including 37 and 28 sites in the East and West Cabinets, respectively.

Confirmed Winter Range

In the East Cabinets five sites totaling 3,002 acres (Table 8) are confirmed winter use areas, while there are 11 such sites totaling 3,837 acres in the West Cabinets (solid line, W1 in Map 2). In addition to having observed goats on these sites, most confirmed use sites fit the following criteria: the mean maximum snow depth index at 4,000 feet is 20 inches or less, or the terrain extends to a low elevation where snow depth indexes are less than or equal to 20 inches. The Deep Creek site is an exception to the rule. It does not have suitable terrain at 4,000 feet so the snow depth index at the lowest available elevation is 28 inches. In Camp Creek and Deep Creek goats were observed at exceptionally high winter elevations, 6,800 and 7,300 feet respectively. These sites had respective indexes of 49 and over 50 inches. Modifying factors were apparently present at both sites. At the Camp Creek site, overhanging rocks and strategically located angular cliff walls intercepted prevailing winds and snowfall, but at the Deep Creek site goats labored in deep snow, staying close to the cliff bases where wells were formed as a result of snowmelt from solar radiation reflection off the black rocks and from snow intercept by the cliffs. Neither Spar Creek nor the Mount Vernon-Spar ridge fit the criteria with indexes at minimum elevations equalling 23 and 90 inches respectively. No apparent modifying terrain features were present to reduce snow depths. A radio-marked female

Table 7. Description of sixty-five sites in the Cabinet Mountains which were examined for mountain goat winter range suitability based on snow depths.

EAST CABINET MOUNTAINS

Area Name	Aspect From 0° N	Slope	Elev (in 100 Ft)	Mean Maximum Snow Depth Index[2] at 4000'	Range
			East Side		
Parmenter Creek	180	80	36-54	5.0	0 -28.0
Flower Creek	140	80	36-52	8.5	1.0-29.0
Flower Creek	170	85	44-70	(9.5)[2]	18.0-50.0
Granite Creek	157	80	38-72	6.5	4.0-49.0
Hauser Peak	90	80	44-62	(13.0)	22.5-45.0
*Deep Creek	180	82	54-74	(4.0)	28.0-49.0
Leigh Lake	180	83	40-60	3.5	3.5-36.0
Leigh Lake	67	85	51-80	(13.0)	32.0-63.0
Snowshoe Creek	160	80	54-64	(23.0)	47.0-57.0
Cherry Creek	170	80	36-58	5.5	2.5-34.0
Bear Creek	180	80	44-62	(5.0)	13.0-57.0
Cable Creek	170	80	44-54	(7.5)	18.0-31.0
Poorman Creek	180	80	48-64	(5.0)	31.0-59.0
Ramsey Creek	157	60	44-56	(16.0)	21.0-39.5
Libby Creek	157	70	46-64	(11.5)	25.0-46.0
W. Fisher River	180	75	38-64	7.5	0 -41.0
Mill Creek	135	80	56-64	(9.0)	35.0-43.0
			West Side		
Falls Creek	250	80	38-50	21.0	20.5-42.5
Swanson Creek	270	85	30-56	20.5	5.5-30.0
Swanson Creek	290	85	32-48	21.5	5.5-39.5
Twin Creek	190	80	34-42	16.0	3.5-20.0
Twin Creek	160	80	40-58	16.5	17.0-55.0
Porcupine Creek	160	80	38-62	16.5	15.0-59.0
*Camp Creek	180	85	42-72	(12.5)	16.5-63.5
*N. Fk. Bull R.	135	80	30-58	19.0	0 -55.0
N. Fk. Bull R.	203	85	44-66	(14.5)	25.0-62.0
*M. Fk. Bull R.	180	80	32-64	15.5	0 -59.0
Chippewa Creek	180	80	54-70	(15.0)	43.0-64.5
Goat Rocks	157	82	32-50	16.0	0 -36.0
Copper Creek	180	80	30-56	15.0	5.0-25.0
*Rock Creek	180	80	36-60	2.5	0 -40.0
*Swamp Creek	113	80	30-54	8.5	1.0-26.0
Swamp Creek	90	73	36-52	14.0	11.5-29.5
Government Mtn.	270	80	24-50	18.5	16.0-40.5
Berray Mtn. S	180	80	28-46	31.0	9.0-45.0
Berray Mtn. W	270	80	24-36	39.0	12.0-31.0
Berray Mtn. NW	290	80	24-40	41.0	14.0-41.0

Table 7 continued. Description of sixty-five sites in the Cabinet Mountains which were examined for mountain goat winter range suitability based on snow depths.

WEST CABINET MOUNTAINS

Area Name	Aspect From 0°N	Slope	Elev (in 100 Ft)	Mean Maximum Snow Depth Index at 4000'	Range
Smith Mtn.	203	75	36-60	19.0	11.0-57.0
Lafoe Mtn.	180	80	42-60	(15.0)	19.0-53.0
Surprise Draw	230	80	42-52	(19.5)	23.0-43.5
Cliff Creek	320	80	42-56	(30.0)	33.0-59.5
Cheer Creek	315	80	44-60	(27.0)	35.0-65.0
Drift Creek	315	85	48-56	(27.0)	41.0-57.0
Thunder Creek	270	85	40-64	21.0	21.0-65.0
*E. Fk. E. Fk. Lightning Cr.	180	80	40-64	15.0	15.0-59.0
*E. Fk. E. Fk. Lightning Cr.	180	70	38-54	19.5	17.0-47.5
E. Fk. Lightning Creek	248	80	40-58	21.0	21.0-57.0
*E. Fk. Peak	203	83	40-56	16.0	16.0-51.0
Lower Lightn- Creek	270	75	30-60	25.5	5.5-63.5
Spar Peak	300	90	40-60	22.5	22.5-58.5
*Vernon-Spar Rid.	0	0	54-60	(60.0)	88.0-100.0
*N. Fk. Ross Cr.	190	80	36-52	15.5	7.5-39.5
*Weasel Creek	160	80	34-40	16.5	4.5-16.5
*Mount Vernon	45	85	32-50	27.0	10.0-47.0
*Mount Vernon	113	85	32-50	21.0	4.0-41.0
*Ross Point	315	85	34-42	25.0	13.0-33.0
*S. Fk. Ross Cr.	270	80	34-44	23.0	11.0-29.0
Sawtooth Mtn.	270	85	42-56	(20.5)	23.0-54.0
*W. Fk. Blue Cr.	270	85	34-50	21.0	0 -41.0
Wiggletail Creek	170	80	34-52	5.5	0 -38.0
*Wiggletail Creek	260	80	34-56	22.0	10.0-54.0
E. Fk. Blue Cr.	90	80	30-54	23.0	3.0-47.0
E. Fk. Blue Cr.	270	80	30-52	23.0	3.0-47.0
Smokey Creek	190	80	30-48	16.0	0 -16.0
Pellick Ridge	180	80	30-56	15.0	0 -50.0

* Areas upon which mountain goats were observed during winter.

1/ Based on equations outlined in Appendix 2.

2/ Numbers in parentheses indicate what the mean maximum snow depth would have been at 4000' if the range had extended to 4000'.

mountain goat was located in Spar Creek during December 1979 and two goats were observed to winter away from cliffs on the Vernon-Spar ridge at about 5,600 feet. These goats were bucking deep snow and apparently feeding on conifers (under which the majority of tracks were observed).

Probable Winter Range

Twenty-two and 11 sites in the East and West Cabinets, respectively, are probable winter use areas based on observations or likely goat tracks during spring and/or fall, suitable environmental conditions and proximity to other seasonal ranges (W2, dashed line on Map 2 and Table 8). The East Cabinet sites totaled 9,199 acres while the West Cabinet site totaled 6,596 acres. All probable use sites exhibited suitable terrain having a snow depth index of 20 inches or less. Although goats are thought to return to the same winter ranges year after year, the confirmed and probable use sites may be used during different years, and during mild years the possibility exists that sites within close proximity may be used during one year by the same animals moving between them. (Chadwick 1973 reported movement between winter ranges of close proximity during mild winters.) Goat Rocks and Swamp Creek (east face) are outlined in Map 2 as probable winter range because they appear to be particularly well suited to support wintering goats even though no evidence of use occurred at either site. An area which may be used during winter but which was not identified since it did not exhibit typical winter range traits is the east ridge of Savage Mountain down to near the mouth of Spar Creek. Four goats were observed during April at this site (L. Schelvan, personal communication) and during the spring 1980 survey a single goat was observed in broken, timbered terrain on the northwest side of Spar Creek. Probable use sites should receive additional winter reconnaissance before activities are planned.

Possible Winter Range

Ten and six sites totaling 3,488 and 1,761 acres in the East and West Cabinets respectively were delineated as possible winter use sites (W2, dotted line on Map 2 and Table 8). It is not likely that these sites would be used consistently since environmental parameters indicate a comparably unsuitable habitat (Chippewa Creek, Hauser Peak, Leigh Lake-NE, Snowshoe Creek, Mill Creek, Sawtooth Mountain, Cheer Creek and Drift Creek). However, all areas identified as possible winter range are known to have supported goats during other seasons, and during mild years these areas may continue to be used into the winter.

Male goats are known to travel extensively between female groups during the November-December rut period and they usually winter on or near the last site accessible to them before deep snows preclude additional forays (Chadwick 1973). The Cliff, Cheer and Drift creeks sites would be particularly important in that they are easily accessible to the confirmed and probable use sites along the East Fork and Lightning Creek.

The possible and probable winter use sites on the fringes of the study area take on added significance, should they serve as islands of isolated habitat along routes between widely separated use areas. For

Table 8. Management situation number, winter range type and size of each area studied for winter range suitability.

EAST CABINET MOUNTAINS

East Side

	Management Situation Number[1/]	Winter Range Types[2/]	Area in Acres
Parmenter Creek	2	P	373.5
Flower Creek - SE	2	P	210.4
Flower Creek - S	2	P	722.9
Granite Creek	2	P	744.0
Hauser Peak	2	S	255.2
Deep Creek	1	C	348.8
Leigh Lake - S	2	P	510.1
Leigh Lake - NE	2	S	212.4
Snowshoe Creek	2	S	270.5
Cherry Creek	2	P	775.8
Bear Creek	2	P	638.0
Cable Creek	2	P	187.0
Poorman Creek	2	S	191.5
Ramsey Creek	2	S	513.6
Libby Creek	2	S	864.8
W. Fisher River	2	P	955.0
Mill Creek	2	S	91.0

West Side

Falls Creek	2	S	332.1
Swanson Creek - W	2	P	203.3
Swanson Creek - NW	2	P	239.6
Twin Creek - SW	2	P	55.6
Twin Creek - S	2	P	186.9
Porcupine Creek	2	P	191.4
Camp Creek	1	C	307.8
N. Fk. Bull River - SE	2	P	683.5
N. Fk. Bull River - SW	2	S	478.1
M. Fk. Bull River	1	C	890.8
Chippewa Creek	2	S	278.4
Goat Rocks	2	P	306.8
Copper Creek	2	P	332.2
Rock Creek	1	C	585.6
Swamp Creek - SE	1	C	869.3
Swamp Creek - E	2	P	361.5
Government Mountain	2	P	745.4
Berray Mountain - NW	2	P	190.0
Berray Mountain - W	2	P	184.8
Berray Mountain - S	2	P	400.2

Table 8 continued. Management situation number, winter range type and size of each area studied for winter range suitability.

WEST CABINET MOUNTAINS

	Management Situation Number[1/]	Winter Range Types[2/]	Area in Acres
Smith Mountain	2	P	781.2
Lafoe Mountain	2	P	540.0
Surprise Draw	2	S	121.9
Cliff Creek	2	S	445.0
Cheer Creek	2	S	239.1
Drift Creek	2	S	317.5
Thunder Creek	2	P	363.6
E. Fk. E. Fk. Lightning Creek (upper)	1	C	321.1
E. Fk. E. Fk. Lightning Creek (lower)	2	P	282.3
E. Fk. Lightning Creek	2	S	390.2
E. Fk. Peak	1	C	531.9
Lower Lightning Creek	2	P	2312.8
Spar Peak	1	C	467.1
Vernon-Spar Ridge	1	C	199.1
N. Fk. Ross Creek	1	C	127.9
Weasel Creek	1	C	126.5
Mount Vernon - N	1	C	103.5
Mount Vernon - S	1	C	186.1
Ross Point	1	C	90.6
S. Fk. Ross Creek	2	P	131.2
Sawtooth Mountain	2	S	247.1
W. Fk. Blue Creek	1	C	1164.4
Wiggletail Creek - E face	2	P	324.3
Wiggletail Creek - W face	1	C	517.9
E. Fk. Blue Creek - E face	2	P	465.4
E. Fk. Blue Creek - W face	2	P	386.5
Smokey Creek	2	P	317.2
Pellick Ridge	2	P	690.9

1 Refer to Chapter 9 for descriptions of various management situations.

2 Winter range types: C = confirmed, P = probable, S = possible.

example, the Smokey Creek, Pellick Ridge, Government Mountain and Berray Mountain sites, may serve as take-off points between the East and West Cabinets if such movements do occur. Movement across the Bull River between the East and West Cabinet is feasible and would seem likely based on river crossing information in the Middle and South Forks of the Flathead River (Singer 1975, Chadwick 1973).

Summer and Transitional Range

Known summer-transitional use areas (identified by ST 1 and Map 2) are defined on the basis of observations while those areas which appear to have all the necessary summer range characteristics but within which few or no observations of mountain goats were made are identified by ST 2 on Map 2. The lack of observation data in the ST 2 areas in the West Cabinet Mountains is due in part to inconsistency in surveys. During four of six aerial surveys weather and to some extent fuel constraints limited flight time in the north half of the West Cabinets (the Idaho portion of the study area). Table 9 describes general areas in which mountain goats were observed on a seasonal basis.

Although winter range appears to be the limiting factor to mountain goat densities in the Cabinet Mountains, quality summer range is the key to the population's fitness. Unless a goat enters the winter in prime condition it is not likely to survive. It is the summer range, providing high quality forage, which sustains the population from year to year. Winter range is selected largely on the basis of security and relatively low snow pack. A low energy budget during winter must be coupled with low energy demands from the winter range and high energy reserves stored from the summer range.

Ridges may be used by goats on an extended basis during any season as part of the seasonal range, but they are particularly important as travel corridors. During spring aerial surveys tracks were observed on the majority of ridge tops. Primary, secondary and tertiary ridges have decreasing importance, the value of every ridge as a travel route must be recognized. Goat tracks, droppings and hair were observed on most higher elevation ridges. Smith (1976) also noted use of ridges as travel corridors. The importance of ridgetops must be recognized in the management scheme to avoid intersecting them with roads, cutting units or other disturbing activities which could directly affect the value of the ridge as a travel corridor - through habitat modification or by modifying the animal's behavior in such a way that it is compelled to avoid the ridge.

Factors Influencing Mountain Goats and Their Habitat

Roads

Motorized human access is the single biggest threat to the survival of mountain goat herds throughout North America (Phelps et al. 1975, Jamieson 1978). Roads into mountain goat range have largely been a product of logging and mining activities, and concommitantly

Table 9. Areas in which mountain goats were observed on a seasonal basis in the Cabinet Mountains.

Vicinity Name	Spring	Summer	Fall	Winter
East Cabinet Mountains				
Scenery Ridge			X[1]	
Cedar Creek	X	X		
Parmenter Creek	X			*[2]
Flower Creek	X	*	X	*
Granite Creek	X	X	X	*
Deep Creek				*
Smearl Creek	X			
Leigh Creek	X	X	X	
Snowshoe Creek	X	X		
Cherry Creek	X	X		*
Cable Creek	X			
Ramsey Creek		X		
Libby Creek	X	X		
W. Fisher River	X	X	X	
Swamp Creek		X		X
Engle Lake	X			
Rock Creek	X	X	X	X
Milwaukee Pass		X		
St. Paul Peak	X	X		
Elephant Peak	X			
E. Fk. Bull River		X		
Chippewa Creek	X			
M Fk. Bull River	X	X	X	X
Bighorn Creek	X	X		
Ibex Creek	X	X		
N. Fk. Bull River	X	X		
Camp Creek	X	X	X	X
Porcupine Creek	X			
Twin Creek		X		
Falls Creek		X		*
West Cabinet Mountains				
Cliff Creek	X			
Drift Creek		X		
Spar Peak	X	X	X	X
Spar-Vernon Ridge	X	*	*	X
Mount Vernon	X	X	X	X
N. Fk. Ross Creek			*	X
M. Fk. Ross Creek		X		
Sawtooth Mountain	X	X	X	
S. Fk. Ross Creek	X	*	*	
Ross point	X	X	X	X
Billiard Table Mountain		X	*	*
Squaw Lookout				*
Pellick Ridge				*
E. Fk. Blue Creek	X		*	*
Wiggletail Creek	X			X
W. Fk. Blue Creek	X	X	X	*
Scotchman No. 2		X		
Savage Mountain	X	X	X	X
E. Fk. Lightning Creek	X	X	*	*

Table 9 continued. Areas in which mountain goats were observed on a seasonal basis in the Cabinet Mountains.

Vicinity Name	Spring	Summer	Fall	Winter
Char Creek		X		*
Thunder Creek	X		X	X

1 X = mountain goat observed

2 * - sign: tracks, droppings, hair

mountain goats have suffered with the influx of people. Part of the problem lies in the behavior of mountain goats: they do not appear wary in comparison to other ungulates (Singer 1975) and they are highly visible and have low rates of population increase. Their defense against natural predators of confining themselves to steep, rocky terrain (Singer 1975) makes them visible, stationary targets for humans. These vulnerabilities suggest that a greater emphasis be put on road management to correct the mistakes of the past and protect goat herds for the future. Roads which can be controlled, such as logging roads, will need to be more stringently managed to compensate for existing and future mining roads which cannot be as readily managed.

Improved access up the Salmon River, the Little Clearwater and numerous tributaries of the Selway River in Idaho (Brandborg 1955), throughout British Columbia (Phelps et al. 1975) and Alberta (Quadleveig 1973 in Chadwick 1973) have wrought the decline or disappearance of mountain goats in these areas. In the late 1950's and 1960's Keeler Creek was roaded to harvest insect infested timber. In the Cheer, Cliff and Drift creek headwaters slopes are more gentle and timbered. Roads were built nearly to the headwalls of the basins on the south slopes and the timber was clearcut. Once the timber was removed a clear view of the opposite cliffs was possible. Mountain goats on the cliffs were within range of legal hunters (unlimited seasons) and poachers shooting from the roads. Several goats were taken out of these drainages during and after the logging operation (J. Dillon personal communication). Phelps et al. (1975) describe a corollary to this example which occurred in British Columbia. In that instance, the B.C. Wildlife Branch was forced to close the hunting season in roaded drainages, learning only after the fact that several herds had been eliminated and the supposed sustained annual yield had really been a function of proliferating road access. The consequences of man's harvest of mountain goats without having reliable population dynamics information has proven damaging to goat herds, and the mistakes can be slow to mend (Kuck 1977b).

In the South Cabinet Mountains on the Lolo National Forest, Burleigh (1978) documented that roads coursing beneath nine winter range cliff sites led to the disappearance of goats on these areas. During this study of the East and West Cabinet Mountains it was learned that goats used to be more numerous in the following drainages: Bear, Ramsey, Poorman, Cable, Libby, Drift, Cliff, Cheer, Halvorsen, West Fork Keeler, and Surprise Draw. The Keeler Creek mountain goat herd decline was a classic case of roads being built for logging purposes which resulted in more goats being taken out of the drainages than for which natural replenishment could compensate. While access provided the means to the end it was unlimited hunting seasons and poaching in the area which was responsible for the herd decline (see Recreation - this chapter). Goats may well have been present in drainages which are now roaded but for which we have no past information. An example is Callahan Creek. At the turn of the century railroad track and roads were built into this drainage for mining operations - so long ago that the presence of goats, if they did occur, may have been forgotten.

Approximately 4,700 miles of roads have been constructed on the Kootenai National Forest with potentially 5,000 miles yet to be built (M. Teigan, personal communication). About 10 percent of the existing roads have some sort of restriction placed on them (Brown 1979). A positive note is that the 5,000 miles yet to be built will primarily be secondary and tertiary roads which are easier to close than collectors or arterials.

Road building seems to be tolerated by goats until blasting or machinery actually threaten physical harm. In the Bunker Creek drainage of the South Fork of the Flathead River, Chadwick (1973) documented mountain goat response to road construction activities and followed their movements to adjacent traditional range 3 miles distant when the commotion in their preferred summer range became too overwhelming. Once roads are built, the occasional passing of vehicles does not seem to disturb the general activity of the goats or promote immediate movements out of an area although in some cases ongoing activities are temporarily suspended for extended periods as goats stop to watch (Chadwick 1973). While deer and elk are prone to flight response goats because of their placid nature, become vulnerable when they are visible to humans.

Goats not only display an infallible attitude when in their typical rocky surroundings but when crossing roads they are not as discrete or cautious as other ungulates. US Highway 2 bisects a traditional mountain goat crossing near Glacier National Park. In studying goats attempting to cross the highway, Singer (1975) observed that, unlike elk, goats continued to cross even if they were subjected to higher mortality and they actively seek conifer cover in approaching the highway before crossing. During 1 year, he observed 13 near collisions between automobiles and mountain goats and estimated that 100 occurred. He concluded that highway losses would probably be cumulative to other sources of mortality and would not be compensated by increased reproduction.

At one time wildlife management agencies were encouraging road building to increase recreational opportunities, but the tide has turned and with proliferation of roads these same agencies are having to curtail hunting seasons to protect the resource. The recreational demand has simply outstripped the supply of goats throughout their range. The British Columbia Fish and Wildlife Branch for example, has closed hunting in several locations because of road access (Hatler 1978 and Phelps et al. 1975).

Topographical and vegetative features can be beneficially used to protect mountain goats and their traditional cliff areas from human observations. Vegetation shields can be used effectively both to aid movements of goats when they are attempting to avoid human detection (such as when crossing roads) and in screening goats from view when roads parallel goat cliffs. The real power of protection however, lies in road management. The Montana Elk Logging Committee has devised several criteria to manage roads for protection of elk such as permanent and seasonal road closures in an effort to decrease road density.

Such an approach is needed for mountain goats but caution must be exercised in extrapolating road closure recommendations based on responses of other wildlife to mountain goats because: 1) goats are generally not as flexible in their behavior as deer or elk; 2) goats derive a sense of security when occupying escape terrain whether or not the site is visible to humans; 3) road density is not as critical as proximity to escape terrain since it only takes one poorly placed road to affect a mountain goat herd.

Map 3 shows locations of roads in relation to mountain goat habitat on the study area. Table 10 is a list of roads with their current road management schedule which occur within mountain goat range in the Cabinet Mountains.

Mining

Mining is the most significant potential industrial threat to mountain goats in the Cabinet Mountains today. The liberties granted mining interests by the 1872 General Mining Law allow little consideration for wildlife (Sheridan 1977). This law was enacted to stimulate the private sector's desire to prospect for minerals, but it is not in the best interest of wildlife since it could not forsee the advanced, capably damaging technology and scope of development which was to come. Environmental safeguards were unheard of at the time of its passage. The law stipulated that access must be granted to anyone who stakes a valid claim on public lands which have not been withdrawn from mineral entry. That claim may be patented, thus converting public to private land. (In wilderness areas the minerals may be patented but the surface remains under federal authority - 1964 Wilderness Act.) Legislation passed more recently on reclamation guidelines still failed to adequately consider wildlife. For example, reclamation "does not necessarily mean that the site must be restored to an approximation of its original condition or that the surface uses after mining will be the same as those existing prior to mining . . . an area might be changed to a . . . recreation complex or a . . . housing area" (USDA Forest Service 1977).

The first recorded mining operation in northwestern Montana is described by Schrader (1911) who states that the activity took place at Libby Creek in 1867, but shortly thereafter the prospector was killed by Indians. Real impetus to the mining industry at the southern end of the Cabinet Mountains came with the Northern Pacific Railroad in 1883, coincident with the gold rush to Idaho's Coeur d' Alene mining district (Crowley 1963). About 1900, a large mining endeavor was initiated along Callahan Creek which included the laying of railroad track to meet with the line at Troy. This operation employed about 300 men in the 1920's. Other late nineteenth and early twentieth century mines in the Cabinets, within currently delineated mountain goat range, were located in Snowshoe, Cherry, Granite, Leigh, Cable, Poorman, Libby and West Fisher creeks.

The process of formation and deposition is different for each mineral but for both silver and copper (the primary minerals being sought in the Cabinet Mountains) mineable grade ore is usually associated with faults or folds (Johns 1970). Where faults are exposed at higher elevations and subsequently develop through erosion

Table 10. Roads on the study area, current management restrictions, management situation in which the road occurs, and suggested alternatives to current management.

EAST CABINET MOUNTAINS

Libby Ranger District

Road No.	Location	Type of Restriction[1]	Management Situation Number[2]	Suggested Alterations to Current Management
4784	Upper Bear Creek (Sec. 19)	Closed to all motorized vehicles	3; adjacent to W 2[3]	Agree
4785	Upper Big Cherry	Closed to all motorized vehicles	3; adjacent to W 2	Agree
4783	Cable Creek	Closed to motorized vehicles except snowmobiles	3; adjacent to W 2	Close to snowmobiles
2317	Poorman Creek	Closed to motorized vehicles except snowmobiles	3: adjacent to W 2	Close to snowmobiles
4781	Ramsey Creek	Closed to motorized vehicles except snowmobiles	3; adjacent to W 2	Close to snowmobiles
2316	Upper Libby Creek	Closed to motorized vehicles except snowmobiles	3; adjacent to W 2	Close to snowmobiles
6745	Great Northern Mountain	Closed to motorized vehicles except snowmobiles	S T 1; adjacent to W 2	Close to snowmobiles
6746	West Fisher River	Closed to motorized vehicles except snowmobiles	3; adjacent to W 2	Close to snowmobiles

Cabinet Ranger District

2220	Galena-Swamp Cr. (Powerline)	Closed to motorized vehicles except snowmobiles	3; road ends in ST 2	Agree
2282	Green Mountain	Closed to motorized vehicles except snowmobiles	3	Agree
150A	Rock Creek	Closed to motorized vehicles except snowmobiles and miners with valid claims in area	3; adjacent to W 1	Close to snowmobiles
2281	Snort Creek-Basin Creek	Closed during the hunting season	3	Agree
2278	Lost Girl	Closed to motorized vehicles except snowmobiles	3; road ends in ST 1	Agree

Table 10 continued. Roads on the study area, current management restrictions, management situation in which the road occurs, and suggested alterations to current management.

Road No.	Location	Type of Restriction[1]	Management Situation[2]	Suggested Alterations to Current Management
		EAST CABINET MOUNTAINS		
		Cabinet Ranger District		
----	Snake Creek-Berray Mtn.	Closed to motorized vehicles	3	Agree
2274	Snake Creek Pass-Goat Rocks	Seasonal closure	S T 1; adjacent to W 2	Close year round
2289	Poplar Point	Closed to motorized vehicles	S T 1; adjacent to W 2	Agree
2275	Berray Mtn.-S. Fk. Bull River	Closed to motorized vehicles	3	Agree
2743	S. Fk. Bull River-Little Ibex Pk. (Chippewa)	Closed to motorized vehicles	3; road ends in ST 1	Agree
2741	Chicago Peak	No restrictions	3; adjacent to ST 1	Year long administrative closure
		Troy Ranger District		
691	Madge Creek (NE¼Sec. 2)	Proposed closure to motorized vehicles	S T 2	Agree
		WEST CABINET MOUNTAINS		
		Troy Ranger District		
4530	Smith Mountain	Closed to motorized vehicles except snowmobiles	3; adjacent to ST 2 and W 2	Close to snowmobiles
4541	Glad Creek (SE¼ Sec. 16)	Closed	3; road goes into ST 2	Agree
4505	Halvorsen Creek	Proposed closure	3	Agree
4505	Cliff Creek	Proposed closure	3; road comes near ST 1 and W 2	Agree
4620	Cheer Creek	Proposed closure	3; road comes near ST 1 and W 2	Agree
4617	Drift Creek	Proposed closure	3; adjacent to St 1 and near W 2	Agree
4627	Stanley Peak	Closed to motorized vehicles	3; adjacent to W 2	Agree
4622	Hiatt Creek	Closed to motorized vehicles except snowmobiles	3	Agree
384	Spar Lake	Closed to motorized vehicles	3; road near ST 2 and W 1	Agree
4626	Stanley Creek	Closed to all but mining and Forest Service authorized personnel	3; road goes into ST 1	Reclaim road from center Sec. 35 over the ridge
----	Ross Creek-Mt. Vernon	Closed to unauthorized personnel	3; road goes into ST 1 and W 1	Reclaim road from Sec. 7 into 5, 6, 35, and 34

Table 10 continued. Roads on the study area, current management restrictions, management situation in which the road occurs, and suggested alterations to current management.

WEST CABINET MOUNTAINS

Cabinet Ranger District

Road No.	Location	Type of Restriction[1]	Management Situation Number[2]	Suggested Alterations to Current Management
2291	S. Fk. Dry Creek	Closed to motorized vehicles except snowmobiles	3	Agree
1118	N. Fk. Dry Creek	Closed to motorized vehicles except snowmobiles	3; road goes into ST 1 and near W2	Close to snowmobiles
----	Big Eddy	Closed from erosion	3	Agree
2292	Dead Horse	Closed to motorized vehicles	3	Agree
409	E. Fk. Blue Creek	Closed to motorized vehicles	3; adjacent to W 2 and ST 1	Agree
2745	Wiggletail	Closed to motorized vehicles	3; adjacent to W 1	Agree

1 All closures are year-long unless otherwise indicated.

2 See Map 2 and discussion of Management Situations in Recommendations (Chapter 9).

3 "Adjacent" means the road is on the same side of the drainage next to the indicated management situation. "Near" means the road is on the opposite side of the drainage but is visible from the indicated management situation.

into cliffs which are quite suitable for mountain goats. Mineralization is not always associated with a fault which has surfaced to form rough country, but in the Cabinet Mountains there are at least 45 drainages in which mining claims occur within or near mountain goat habitat. The following is a list of drainages in the Cabinet Mountains, where this has occurred: East Cabinets - Granite, Leigh, Snowshoe, Cherry, Bear, Cable, Poorman, Libby, West Fishery, Bramlett, Baree, Rock, West Fork Rock, Chicago, Copper, Moran Basin, Placer, East Fork Bull River, Bull River, South Fork Bull River, Middle Fork Bull River, North Fork Bull River; West Cabinets - Callahan, Keeler, Drift, Hiatt, Fairway, Whoopee, Spar, Cub, Pooch, Club, Stanley, Weasel, Ross, North and South Fork Dry, Hamilton Gulch, Star Gulch, Big Eddy, East Fork Blue, Wiggletail, West Fork Blue, Regal, Lightning, Rattle. Areas of current major exploration or development activity occur in three areas of very important mountain goat habitat including Mount Vernon, Ross Point and Rock Peak.

Mining claim data presented in Map 3 was provided by the Bureau of Land Management mining claims record divisions and was incomplete due to the tremendous backlog of claims yet to be processed under the October 1978 filing deadline. Symbol sizes in Map 3 relate to the number of claims in each section. Location information on over 2,000 claims was provided. The base map shows some claim groups not provided by the BLM. ASARCO Inc. and Bear Creek Mining Company accounted for over 1,800 of the claims while 59 other claimants held approximately 260 claims.

Similar conflicts occurring elsewhere provide insight for management in the Cabinets. McFetridge (1977) points out that the loss or disturbance of ranges that are occupied by mountain goats through exploration and extraction of coal deposits is a major threat. In British Columbia, coal exploration has correlated with a decline of mountain goat populations and depressed populations have not shown sign of recovery (Pendergast and Bindernagel 1977). Pendergast and Bindernagel (1977) explain that a common erroneous notion exists that goat populations move to new habitat when harassed, but the areas which were purportedly vacated, were sites having the highest capabilities to support goats. They documented that there were no areas to which the large population could move which would be capable of sustaining them; and in the event that such an area existed, it would already be supporting resident animals. Klimstra et al. (1979) indicate that two general categories of impacts exist which are not technologically controllable; they include human population changes and post-mining land use.

Klimstra et al. (1979) indicate that "the ancillary human activities throughout the area surrounding a new mine will typcially cause much more significant impacts" than the mine itself. They relate that in mining impacted areas of northwest Colorado, population growth rates have been 47 percent and 19 percent in two counties over a 5-year period but that during that same period registrations for recreational trucks increased over 550 percent in one county and 383 percent in the other.

Wildlife road kills dramatically increase in mining areas as a result of employees en route to and from work. Fencing of roads is known to inhibit wildlife movements and may concentrate wildlife on roads, exposing them to hazards. Road kills can be a regular occurrence where mine roads are poorly located and cross wildlife travel routes. The losses are magnified if worker shift changes coincide with dawn and dusk wildlife feeding periods. The road crossing over Mount Vernon from Stanley to Ross Creek crosses an important mountain goat travel route. Conflicts could arise if this road were used on a regular basis to gain access from the north side of the mountain to the south adit or mine company buildings on the Ross Creek side of the mountain.

Helicopters permit miners to access claims quickly and without the effects a road could have on the environment. This advancement in technology has been preferable to road construction; however, there are considerations which must be made when flying over mountain goat terrain. Helicopters cause very strong goat flight and hiding responses and even if the goat remains motionless in a secure spot its anxiety level is likely to be raised. MacArthur et al. (1979) measured a 20 percent rise in mean heart rate in bighorn sheep when they merely observed humans for 1 to 10 minutes. They observed raised heart rates in sheep in response to vehicles and aircraft in close proximity and although the disturbance disappeared the elevated heart rate continued for an extended period. When harassment occurs on winter ranges and/or spring kidding grounds the increased stress is highly undesirable. During this study a young goat along Thunder Creek was observed to fall about 10 feet onto its back into deep snow as it scrambled along a bluff toward timber in a panicked effort to escape our hovering helicopter. Movement of goats from the White Clouds area of Idaho was coincident with mining associated helicopter activity in the area (L. Pengelly, personal communication).

Logging

Logging operations in the Cabinet Mountains do not appear to have directly affected mountain goats. However, since goats are not easily observed in timbered areas the role timbered areas play in the yearlong ecology of goats in the Cabinets is not fully understood. Opportunities for conflict do exist since 60 percent of Montana's timber comes from the National Forests in the northwestern portion of the state (Johnson 1972 in Burleigh 1978). Rideout (1974) recorded that goat use of timber, based on radio-transmitter monitoring, is greater than would be expected from observation information, which is logically biased against observations in timber. Information collected on a radio-collared female goat marked in the West Cabinet Mountains during this study suggests that a far greater use of timber occurs than what the general aerial observations would indicate since all locations of this animal were made in heavily timbered areas.

To the present, man has not significantly physically altered mountain goat country in the Cabinets through timber removal, but future market prices and advance technology could transform once uneconomical timber into harvestable stands. Logging operations have indirectly affected mountain goats through road construction into, through or adjacent to mountain goat habitat. In British Columbia, Phelps et al. (1975) describe systematic mountain goat herd declines when hunting regulations did not keep pace with logging access. After logging was completed, the roads remainded open and the herds remained vulnerable to hunters. Hall and Bibaud (1978) and Quadlevieg (1973 communication in Chadwick) outline the history of mountain goat hunting in Alberta up until 1970 when the entire province was closed to goat hunting in an effort to rectify past over-exploitation of goats which had been accommodated by road construction for logging and mining.

In the Cabinet Mountains, mountain goat range is similar more to that of the west coast than to goat range in the rest of Montana. Winter range occurs as low as 3,000 feet with isolated areas extending even lower. These sites are generally surrounded or occupied by timber. Typical summer range in the Cabinets might be characterized as sites above 5,000 feet associated with *Abies lasiocarpa* habitat types, cirque headwalls and timberline/rock terrain. Although summer range areas generally are not suitable for timber removal because of fragile soils, oversteepened slopes and short growing seasons (slow recovery rates) some cuts on the forest abut or encroach into such areas. The possibility of future logging occurring on or near either winter or summer mountain goat ranges is not unlikely.

Map 3 gives more insight into the proximity of mountain goat seasonal ranges and known cutting unit boundaries (solid green line - actual cutting units taken from timber stand atlases and stand examination records) and 5-year timber sales (dashed green line - proposed areas within which cutting units will occur). Timber sale and cutting unit information is incomplete but the available information which was plotted shows that the majority of timber harvest activity has occurred at the edges of known summer-transitional range (dashed black line). Some winter ranges (light solid black line) on which timber harvest activities have taken place have suffered herd losses.

Three fundamental ramifications may occur from logging on or near mountain goat ranges. The first and most immediate effect is disturbance from the operation. The shorter the duration of logging and follow up activities, the less the impact should be. Second, a herd's security is jeopardized with road construction into an area and is compounded if trees and other vegetation are removed which previously shielded goat terrain from human view. The third possibility involves direct habitat alteration by removing the vegetational components which are important to goats for forage in thermoregulation and as security cover. This may also be a long-term impact.

Based on literature concerning ungulate response to logging operations, it can be expected that the result of logging activities on mountain goat habitat would be to displace goats from that area. Chadwick (1973) studied the response of goats to road building and logging operations in the Swan Range and noted that the animals vacated the area and

moved to an adjacent traditionally used site on the opposite side of the ridge after construction and blasting reached their usual summer use area. Elk are known to be displaced from drainages where logging is occurring and they may move up to 4 miles to avoid the disturbance (Lyon et al. 1979). Goats, however, are less flexible and evolutionarily attached to seasonal use sites; their opportunity for accommodation is less than for elk. The reaction of goats to logging initially appears to be less dramatic because often they remain in the disturbed area temporarily or they may congregate onto a less disturbed area of defined seasonal use. Either reaction may induce physiological stress from noise produced from the disturbance, prevention of use of preferred or necessary sites, overuse of an area that is normally used at a different time of year and overcrowding.

It was pointed out previously that the quality and quantity of summer forage likely determines the average yearly nutritional level and thus survival of the animal. For this reason any disruption of goats on summer range could have long-ranged consequences. Disruptions would include not only physical displacement of goats or alteration of their habitat but also any activity which would reduce the animals' nutritional intake during the season. Chadwick (1973) states that goats preempt normal activities to stand and stare for long periods in the direction of human activity.

Two different circumstances occurred in the Cabinet Mountains where the timing and placement of logging sales and the associated roads influenced the security of local mountain goat herds. The first example involved placement of a sale and its access road on the same side of a drainage as goat habitat. The second example occurred when a sale and road were located on the drainage face opposite goat habitat. Both types of areas were logged during summer, but in the first instance the sites were used year-long while in the second the sites were used primarily during summer. Both types of areas experienced herd declines although the one which was located across the canyon apparently sustained immediate declines as a result of construction workers and loggers becoming aware that goats were there and hunting them (Drift, Cheer and Cliff creeks). This situation occurred prior to the time of limited goat hunting permits. The cause of declines where sales and roads occurred on the same side of the drainage as goat habitat (Big Cherry, Bear, Cable, Poorman, Ramsey, Libby, West Fisher creeks) are not well understood, but it is hypothesized that these goats were more difficult to see and at the time of the sale they were probably at higher elevations so their use of the area was not so quickly recognized. Nevertheless, the new roads remained open and unlimited hunting seasons and increased poaching likely took its toll. Additionally, snowmobile use of these areas may have disturbed goats on these winter ranges.

In both instances, vegetation which could have screened goat range from view was removed from the road right-of-way. Where the road was placed across the drainage, visibility was easier than where the road was on the same side of the drainage and the observer was forced to assume an uncomfortable position to scope up the hill (which was partially obscured by terrain). As far as timing of operations those which took place in Drift, Cheer and Cliff creeks would have been best carried out during winter to avoid the summer use period, while those in the other situation were done at the proper season -- summer -- when the least number of goats were present near the sale site.

Roads in all drainages mentioned here except Bear Creek were closed in 1980 or will be in 1981 according to the Kootenai National Forest Travel Plan and rangers on the affected districts. This action will decrease human disturbance and will be a positive step toward herd re-establishment in these drainages.

For some goats, winter and summer range are the same, but for the majority of goats summer range is at higher elevations which are connected to winter range by ridges. Bissecting a ridge line travel corridor may create trauma or a real physical barrier to movement between seasonal ranges. Slash may also create movement barriers. Areas having slash of over 1-foot would be undesirable.

The value of vegetation in providing forage, thermoregulatory needs and security cover was discussed previously. Logging in mountain goat habitat would influence these factors but the extent and degree would vary with the operation, site location and type of goat habitat involved. Logging on goat range may risk disabling an area or making it temporarily unusable and possibly reduce its value to mountain goats who must teach young to use the site on a yearly basis. Even one goat use site is important. Trading it off may have permanent consequences since goats may not reestablish once the disturbance is gone if the site is on the periphery of goat range and traditional travel routes to other locations do not pass near the site.

Prescriptions for logging elk and deer habitat have been devised to reduce the activities effect on security and thermal cover needs (Thomas et al. 1976) but Thomas cautions that winter range because of its scarcity and intensity of use is more sensitive to land management decisions. The consequences of error in managing winter range are hugely magnified over that of summer range. He explains that any cover is better than no cover and that multi-tiered stands are better than single-tiered stands. Specific security and thermal cover needs for mountain goats are not known.

Livestock Grazing

One land use practice which is not dependent on roads is grazing of livestock on national forest lands. In this region of the state, little livestock grazing occurs. Some of the planning unit documents which were reviewed indicated that the area could support more grazing.

It is unlikely that cattle would ever come to occupy mountain goat habitats on the study area. Deer and elk occur in areas delineated as mountain goat range and at lower elevations where grazing allotments are normally issued. The effect of increased cattle grazing in the Cabinet Mountains would be to displace deer and elk due to forage and spatial competion and behavioral tendencies of wildlife to avoid cattle. This displacement may lead to increased competition between mountain goats and deer and elk.

While cattle are not a direct threat to mountain goats, domestic sheep can be since they are often herded onto high subalpine ranges. No sheep grazing allotments occur on the study area.

The current grazing system is probably having little or no effect upon mountain goats on the study area at this time. It is recommended that grazing not be increased in the Cabinet Mountains in view of the other demanding land use practices which are currently affecting wildlife habitat to a yet undetermined degree.

Recreation

Outdoor recreation is a legitimate use of our national forest land and in terms of mountain goats, viewing, photography and hunting often lead to a better understanding and appreciation of the species as well as increased interest and concern for its welfare and proper management. However, uncontrolled and intensive outdoor recreation activities in mountain goat habitat may result in detrimental consequences for goats. Recreation requires proper management to no less degree than other forest activities. Acknowledged forms of recreation include: riding in passenger vehicles, snowmobiling, horseback riding, skiing and hiking. Once access has been gained to an area other activities are often undertaken including berry picking, wood gathering, picnicking, camping, fishing, hunting and photographing. Although certain forms of recreational activity are legal and socially accepted, they may become detrimental to mountain goats and other wildlife if they are undertaken by increasing numbers of people or if recreation managers fail to identify conflict areas and thus do not take steps to avoid impacts to the wildlife. In such cases, a socially accepted and authorized activity becomes detrimental to the resource. The opportunity for conflict is greatest when the activity involves motorized vehicles, although the number of people taking to the hills on foot, skis and horseback is beginning to affect the solitude and security of wildlife as well.

Nonmechanized Recreation

Nonmechanical forms of recreation such as hiking, camping, horseback riding and skiing are not thought to have reached detrimental levels as far as mountain goats are concerned in the Cabinet Mountains, but the potential is there. Management opportunities to avoid conflict are less defined and more complex to implement and enforce for these forms of recreation than for control of motorized vehicles. Appendix 5 lists inventoried trails on the study area. These trails are not known to receive enough use to be in conflict with seasonal needs of mountain goats. The current knowledge of goat habitat and concentration areas is thought adequate to guide the land manager in making decisions about which trails to maintain in the future and where to locate new trails to avoid important areas. The trails to Leigh Lake, Wanless Lake and Moran Basin receive the heaviest use on the study area. The Leigh Lake trail takes hikers within easy viewing range of mountain goats at all times of the year, and for this reason it is used heavily by hunters.

Mountain goats have been classified as "wilderness-associated wildlife" (Schoenfeld and Hendee 1978) because they are commonly associated with habitat characteristics of classified or proposed wilderness. The Cabinet Mountains Wilderness Area affords an excellent opportunity to view mountain goats in their native environment. In addition to the wilderness,

eight inventoried roadless areas in the Cabinet (Bull River - Clark Fork and Hoodoo Planning Units) also include important goat habitat. Efforts are often made to maximize recreational opportunities on National Forest lands by drawing attention to wildlife viewing vantage points. When increased viewing of mountain goats is the objective, the advantages of temporary human pleasure must be weighed against the animals' welfare. During his study of mountain goat/human interactions, Singer (1975) observed that goats tried to avoid humans in all instances. In 84 percent of the interactions where humans approached goats, the goats altered their behavior. A mountain goat can be an extremely dangerous animal to the unsuspecting tourist who approaches too close. The real problem for the herd's well being, however, comes from those who have vandalistic intentions. Increased human interest in the outdoors will naturally lead to increased confrontations between man and goat. This process need not be accelerated.

Snowmobiling

Uncontrolled snowmobiling can be a signficant threat to mountain goats. Winter and early spring are the most stressful periods for goats, so any activity which increases stress during these seasons is a serious detriment. The biggest problem arises when snowmobiles are used abusively to harass wildlife. Harassment may be unintentional, however, through poor placement of designated routes.

The road from Ross Creek onto the south face of Mount Vernon has been closed during winter and beginning in 1979, it was closed all year with a locked gate and sign. This road courses into winter goat range and ends on the mountain top. During winter 1979-80, snowmobile tracks were located on two occasions in the goat winter range area known as the Spires, and on top of Mount Vernon off of the road within 400 yards of the top of the winter range. Snowmobilers had illegally been below, into and above the winter range area on more than one occasion. A dead mountain goat was found along this road during spring 1979 (T. Morris, personal communication) but whether the animal succumbed of natural causes, was shot or predisposed from harassment could not be determined. In any event, the presence of snowmobiles on mountain goat winter range is not in the best interest of this wintering herd. Violations of road and trail closures are likely to be more common when enforcement is low.

Hunting

A long-held wildlife management maxim has been: natural compensation mechanisms can be stimulated by increasing mortality; hunting, therefore, could be substituted for natural mortality and used to encourage reproduction. While this does appear to work at times for some species of wildlife having high natality rates and adaptive behavior, hunting of mountain goats must be carefully controlled to be sure that removals fall within the limits of recruitment. Hunting losses often occur in addition to natural mortality and do not appear to be compensated by increased natality (Kuck 1977b).

Hard rock mining ventures are bringing hundreds of people into the Cabinet Mountains. Klimstra et al. (1979) note that "any human population increase is accompanied by additional hunting/fishing pressures but the decided preference of mining personnel for these forms of outdoor recreation activities causes an additional increase beyond that which would normally be expected for that incremental increase in population." For example, in the Gillette, Wyoming area, the mean number of recreation days per day of hunting season increased over 240 percent from 1971 to 1977 for antelope and by 143 percent for mule deer hunting, but the human population increased only by 112 percent. With several mining operations occurring in the Cabinet Mountains, similar circumstances could be expected to develop.

Mountain goats have been hunted in Montana since man's arrival in the region and evidence indicates that goat populations can withstand limited hunting mortality as long as access to goat habitat is limited as well. Unless all herds are equally difficult to reach, however, hunting pressure is not distributed evenly. Once roads are built into areas harboring goat herds, man concentrates in these areas and continues to put pressure on the easily accessible animals until the herd is significantly reduced or extirpated. The Keeler Creek drainage in the West Cabinets was an example of this.

The Montana Fish and Game Commission first established a hunting season for mountain goats in 1905 which allowed one goat to be legally taken per year per hunter on the general big game license. Statewide closures followed; in 1954, 15 permits were issued for hunting district 100 (Table 11). Hunting district 100 originally included the Thompson Falls areas (now hunting district 121) which was separated in 1959. Until 1978 hunting district 100 included both the East and West Cabinet Mountains. Then the area was cut in half to include the East Cabinets only, with no hunting occurring on the west side. Since 1954 over 300 mountain goats have been taken legally from hunting district 100. The number of goats taken each year has varied from 56 in 1957 to 0 in 1968. Over a 10-year period from which sex information was available, about 54 percent of the goats taken were males (Weckwerth and Cross 1971-80). The increasingly restrictive seasons from unlimited to five permits is the result of decreasing hunter success (fewer goats being taken in relation to the number of hunters). In addition to declining hunter success, fewer goats were being taken. During the 10-year unlimited period, the overall hunter success was 22 percent as compared to 33 percent for the 8 years of permit hunting (25 to 10 permits) which followed. During the last 6 years since 1974, when five permits were issued, the hunter success has averaged 80 percent. It is interesting to note that since the limited goat season was initiated in 1966, no more than five goats have been taken in any 1 year although the number of permits available has varied from 5 to 25.

Hunting in the West Cabinets of Idaho was unlimited from 1955 through 1965 during a 1 week season. During 1966 and 1967, one permit was available for Idaho's Unit 1 which included a portion of the Purcell and Selkirk mountains as well as the Cabinets. From 1968 through 1970, five permits were issued for Unit 1. Since 1970, mountain goat hunting

has been closed in the Cabinet Mountains of Idaho. During the 14-year period from 1957-1970, the Idaho Department of Fish and Game estimates that 13 goats were legally harvested in the Cabinet Mountains (R. Rogers, personal communication).

Table 11. Mountain goat hunting history in the Cabinet Mountains from 1954 to 1980.

Year	Number Permits	Number Hunters	Harvest
1954	15	15	7
1955	20	20	5
1956	unlimited	61	20
1957	unlimited	210	56
1958	unlimited	293	44
1959	unlimited	40	13
1960	unlimited	96	21
1961	unlimited	31	15
1962	unlimited	1/	25
1963	unlimited	1/	19
1964	unlimited	1/	12
1965	unlimited	113	20
1966	25	19	3
1967	25	20	5
1968	10	14	0
1969	10	7	2
1970	10	8	4
1971	10	9	4
1972	10	9	3
1973	10	10	3
1974	5	5	4
1975	5	5	4
1976	5	5	4
1977	5	5	2
1978	5	5	5
1979 2/	5	5	5
1980 2/	5	5	5 (plus 1 illegal)

1/ Information not available.

2/ Hunting limited to East Cabinet Mountains

It is apparent that over the years the demand for hunting recreation not only exceeded the ability of the resource to sustain the pressure, but that our knowledge of the population dynamics of mountain goats was developing too slowly to enact the needed restrictions to keep the population from declining. The responsibility of this undesirable circumstance falls on both the wildlife and land manager because the problem of bringing people into contact with goats is compounded geometrically as the human population expands and the road system proliferates. If hunting seasons and habitat are both properly managed, hunting can provide an important recreational opportunity without negatively affecting wildlife populations.

Poaching by its very nature is difficult to document. Burleigh (1978) discusses poaching in the South Cabinet Mountains as a distinct factor in mountain goat herd declines.

In the early 1930's, six goats were reported to have been shot on the Spires of Mount Vernon and left because the hunter could not retrieve them from the cliffs (C. Wier, personal communication). The hunters had spotted the goats from the road which passed through the valley but they had not reckoned how to retrieve the animals from the cliffs. A long time resident of the valley, C. Wier, related that out of curiosity he killed a group of three mountain goats because he had simply never seen mountain goats before.

The risk of the poacher being discovered is greatly reduced if the act can be accomplished quickly (using road access) while the likelihood of the event taking place is magnified by the relative ease of its accomplishment.

Fire

The role which fire plays in the ecology of the Cabinet Mountains' goat population is not clear, but the fact that mountain goats and fire have coexisted for thousands of years in North America is certain. Mountain goats have a narrow ecological tolerance which prevents them from taking advantage of a rapidly changing environment. For these reasons, they have been equated with climax vegetation communities (Schoenfeld and Hendee 1978). Even in these communities, however, fire plays an important role.

The United States is categorized into several regions of fire-dependent ecosystems. The Cabinet Mountains are included in the Intermountain Region (Heinselman 1977). According to Heinselman, the climate of this region "retains some Pacific maritime influence, tending toward heavy snow winters and dry summers. Summer thunderstorms are frequent over the entire region and lightning ignitions are extremely common because of the frequency of prolonged droughts . . . lightning fire occurrence rate of 20 to 60 fires per million acres per year for most of the region is normal. At higher elevations, on some north slopes, and farther north on slopes with more maritime climates, the fire regime has often been one

of long-interval (150-300 years) . . . Fire suppression in the last 60 years has probably altered fuels and vegetation most in areas that were subject to periodic light surface fires. The heavy-fuel, long-interval, crown-fire-regime areas and higher elevation forests have probably not been affected so much because many areas would not have burned in this period in any case."

Major forest habitat types in western Montana which mountain goats occupy include the *Pseudotsuga menziesii* series and the *Abies lasiocarpa* series. Pfister et al. (1977) describe the former in terms of drier and wetter habitat types. The wetter types are similar to the *Abies* habitat types in that they have long fire-free intervals of up to hundreds of years. These are more typical of Cabinet Mountains summer goat range. Lightning caused wild fires have allowed *Pseudotsuga menziesii, Larix occidentalis* and *Pinus contorta* to dominate most stands in the lower subalpine category of the *Abies lasiocarpa* series. Fire is apparently more frequent and less intense in the dry habitat types like *Abies lasiocarpa/Vaccinum scoparium, ABLA/Xerophyllum tenax* and less frequent and more intense in the moist ones like *ABLA/Menziesia ferruginea, ABLA/Galium triflorum* and *ABLA/Clintonia uniflora*. Although more lightning strikes may occur in the upper subalpine forests, cool, moist conditions and broken rocky terrain limit the spread of fires. Fires at timberline may be even more localized although they may prevent reestablishment of trees for several decades (Arno 1970).

Map 4 superimposes known fire data on mountain goat range. Without having historic fire occurrence and intensity information on selected goat range sites, it is risky to hypothesize about the influence of fire (or recent lack of influence) on goat range in the Cabinet Mountains. In extremely steep terrain where fires are known to create their own upwind drafts, it seems unlikely that under normal circumstances fuels would have had the opportunity to build up to the point of being obstacles to mountain goat movements. However, on certain known use sites, heavy debris accumulations have apparently made movements difficult for goats. It is apparent from trails through the debris that with repeated use and much energy, goats have beat winding trails through heavy downfall. The consequences of an intense fire on such sites at this point in history after 6 decades of fire suppresssion could be devastating to a local mountain goat herd which yearly relies on the site for seasonal needs. If such a fire were to occur on an area which is not used during winter, the goats may accommodate or they may temporarily decline in numbers for a matter of two or more goat generations until the site becomes productive summer range once again. The complication lies with traditional use of an area and the likelihood that summer nutrition dictates winter survival. Olmsted (1979) noted that 50 years after a fire in a subalpine area of the Cascade Mountains the site was still unproductive because the microclimate had changed, germination was difficult and plant growth was very slow. There are soil erosion problems associated with intense fires on steep slopes, particularly at higher elevations where the growing season is restricted and the soils are shallow. A severe fire on mountain goat winter range could spell the demise of an entire wintering herd for two reasons. First, females generally occupy preferred cliff areas, to which

they return year after year. Their offspring have assumed use of the traditional seasonal ranges. Since their behavior is rigid, alternate areas, if available, may not be used. Second, goats in the Cabinet Mountains have selected comparatively low snow depth areas on which to winter. The majority of these sites have at least some well developed overstory conifer canopy which functions to intercept snow. If the understory and overstory are removed by fire, both forage and cover are also removed. D. Hebert (personal communication) indicates that timber is critical for the survival of mountain goats along the British Columbia coast since it functions to reduce snow depths.

Regularly occurring ground fires in mature overstory stands stimulate shrub production while killing conifer seedlings (Arno 1976). Such fires would remove the competitive confier seedlings and debris often enough that ladder fuels and accumulations of downfall would not be present to allow flames to reach the overstory crowns. It would seem that in the Cabinet Mountains where overstory is an important component of mountain goat winter range, regular low intensity ground fires may be an important rejuvenating feature of winter range.

Lyon et al. (1978) reviews the pros and cons of fire to wildlife and cites several authors who explain that snow depth, duration and crusting on burns are profoundly different from those in the unburned or unlogged forest and these results can be either good or bad depending upon the species affected. But for mountain goats, crust formation and increased snow depths on wintering cliffs is not in the best interest of safety or body maintenance.

It cannot be assumed that fire increases the nutritional value of forage; indeed burning of some browse species kills rather than stimulates (Olmsted 1979). Lyon et al. (1978) cites numerous authors who state that "the level of nutrients in plants after burning may be unchanged, increased, or decreased, depending on season, soil, weather, fuels, the fire and other factors. Before burning takes place on mountain goat range, the forage species targeted for manipulation must be identified, their ecology understood and the desired management goals outlined."

CHAPTER 6

RECOMMENDATIONS

Survival of our nation's wildlife resource will require a continual and active commitment from private, state and federal wildlife and habitat managers. There is an acute need for such a commitment to mountain goats, where in Montana over 95 percent of their habitat occurs on lands administered by the Forest Service. The perpetuation of mountain goats in Montana will require a detailed understanding of the unique biological needs of this species and application of this knowledge to management of established mountain goat habitat. This habitat management plan was undertaken to study both the biology of mountain goats and the various human activities occurring in the Cabinet Mountains in order to provide management guidance where conflicts may arise.

Recommendations for management of mountain goats and goat habitat in the Cabinet Mountains have been divided into three parts. First, the area has been delineated (Map 2) according to seasonal ranges and the sensitivity of each to habitat manipulation or human activity. Explanation and interpretation of Map 2 for management purposes is provided. Second, recommendations are given regarding specific activities and other factors capable of influencing mountain goats and their habitat. Third, the need for a long-term commitment to conscientious management is discussed in terms of continued monitoring of the species and human activities in the area. The high suitability of the mountain goat as a management indicator species (capable of reflecting the environmental pulse of other wildlife species in certain habitats of the Cabinet Mountains) is discussed.

Management of Seasonal Mountain Goat Ranges

Map 2 identifies three management situation numbers (1, 2 and 3 -- in order of decreasing sensitivity to human activity) and two seasonal range designations (W-winter, ST-summer/transitional). The numbers and letters in various combinations signify different management approaches.

Management Situation 1

Areas referred to as Management Situation 1 constitute critical mountain goat range during summer and/or winter and are designated on Map 2. Management Situation 1 applies when mountain goats have been documented to regularly use a specific area during one or more seasons. Specific management depends upon the relevant season.

Management Situation 1 areas are the most sensitive to habitat manipulation and human activity. Every effort should be made to maintain the present integrity of Management Situation 1 areas. Mechanized human activities should not occur in these areas. Human activities on adjacent areas should be kept to a minimum during the seasons when these areas are used by goats. In cases where human activities in or near a Management Situation 1 area are unavoidable, every precaution should be taken to

minimize effects to goats and their habitat and the activity should not occur for longer than 1 year to avoid disruption of traditional use patterns. Habitat improvement projects should not occur on Management Situation 1 areas without first monitoring and analyzing the results of such attempts toward habitat improvement on Management Situation 2 areas.

Management Situation 2

Management Situation 2 (designated 2 on Map 2) applies when an area contains suitable summer and/or winter mountain goat habitat but where infrequent sightings of mountain goats were recorded. Management Situation 2 areas may have had historic populations of goats but do not currently support them during the designated season, or the area may not have been known to have ever supported goats but the site appears to have all of the features of suitable habitat.

Activities planned in or near Management Situation 2 areas should be preceded by a thorough ground inventory of the area by a biologist to establish the presence or absence of goats or sign (hair, tracks, droppings) and the proximity to Management Situation 1 areas. If observations or evidence suggest that the site is being used by goats, the season of use must be determined, and the area upgraded to Management Situation 1. If evidence of goat use is not determined, then assuming the area is not adjacent to or in close proximity to a Management Situation 1 area, the activity may proceed with the stipulation that the site is not taken out of potential use by goats for more than a few years.

Management Situation 3

Management Situation 3 (3 on Map 2) refers to areas within the study area boundary which are classified as mountain goat habitat exclusive of identified winter range and summer-transitional range. Areas marked as 3 are not known to be important summer-transitional range or winter range, but because of their juxtaposition to Management Situation 2 areas, it would not be unusual to observe goats in Management Situation 3 areas. Although no particular terrain is characteristic of Management Situation 3 areas, features representative of ST or W range may be present. For this reason, prior to commercial activities, the vicinity should be inventoried on the ground by a biologist to determine whether all or portions of the area appear to be suitable seasonal range and/or whether mountain goat sign exists in the area. If either or both occur, the site should be upgraded to Management Situation 2 or 1 and the necessary management prescription applied to protect mountain goat habitat values. ~~If a~~ Management Situation 3 area is adjacent to another management classification area, steps should be taken to treat a buffer zone around the higher priority area within the Management Situation 3 area.

Winter Range

Mountain goat winter range is defined from observations made during January, February and March although November, December and some April observations were also used. Winter range may occur at any elevation in the Cabinets but generally the map delineation is confined to 3,000 feet and above with exceptions where suitable terrain extends lower. Slopes

on identified winter range areas are generally about 80 percent and exposures vary from northeast to south to northwest, with the majority of critical areas occurring on southerly, east or west aspects. If a site was used on a year-long basis, a W designation took priority over ST on Map 2. W 1 (winter range/Management Situation 1) areas should receive complete ground reconnaissance to be sure that its year-long use is understood.

Winter ranges are classified as confirmed, probable and possible, based on observation and sign data collected during this study. These differences are shown in Map 2 with different gauges and patterns of lines. All confirmed sites received a Management Situation rating of 1 whereas probable and possible sites were designated as 2. More intensive ground reconnaissance on probable and possible use areas may justify upgrading of these areas. Specific terrain features of each site are described in Table 7. More detail regarding the known seasonal use of each general area in the Cabinet Mountains is provided in Table 9.

No human activities should occur on or near confirmed winter range (W 1) during winter and spring. The distance which a mechanized activity should be from W 1 range during periods of goat use will be determined by the type of activity. If a W area is used year-long, further precautions are necessary. Probable and possible winter range (W 2) require careful ground reconnaissance during winter prior to initiation of activity. If goats are observed or winter sign is detected, the area should be upgraded to Management Situation 1 and receive appropriate management.

Summer-Transitional Range

Mountain goat transitional range in the Cabinet Mountains refers to observations made during spring (April, May, June) and fall (October, November, December) migrations between summer and winter ranges. Summer range was delineated on Map 2 primarily based on the 5,000 foot elevation contour although the line varies with topography. Transitional range is combined with summer range (July, August, September) into summer-transitional (ST) range. Clusters of observations noted during summer and migration periods define critical summer range (ST 1). ST 2 areas were delineated on the basis of topography, elevation and infrequent observations. All ridge tops within the study area should be managed to retain maximum security; they should be considered potential travel corridors and treated as ST 1 or 2 areas.

Mechanized human activities should not be permitted in ST 1 areas. In ST 2 areas, activities may occur provided the stipulations discussed in the Management Situation 2 areas are followed.

Management of Specific Activities in Mountain Goat Habitat

Roads

Proliferating road access has been the single biggest threat to mountain goats in the Cabinet Mountains. Road construction should not occur on Management Situation 1 and Management Situation 2 areas identified on Map 2. Roads which currently exist in Management Situation 1 areas

should be reclaimed or at least have restrictions imposed during seasons in which goats are known to use the area (Map 2). In Management Situation 2 areas, existing roads should receive field analysis by a biologist to determine whether their use may negatively affect goat use of the area. If a positive determination is made, the road should be permanently closed, reclaimed or have restrictions imposed. Road construction should not occur within 0.5 mile of mountain goat escape terrain occurring in Management Situation 1, 2 or 3 areas. Roads which have been open to motorized winter access and which occur within 0.5 mile of winter ranges (Management Situation 1 and 2) should be closed during winter and spring (November 1 through June 15).

Construction of new roads in identified mountain goat habitat should incorporate the following guidelines: 1) ridges should not be crossed, 2) the road should be located at least 0.5 mile from goat terrain, 3) terrain or vegetation should screen the view of goat habitat from the road, 4) security cover vegetation should be maintained at the edge of the road to aid wildlife crossing, 5) slash should be removed along road right-of-ways to prevent impairment of wildlife movements, 6) roads should not be fenced. Although fencing is often intended to prevent wildlife from getting onto the road, once they do, fences tend to trap them there. Fences are particularly impassable to goats because they tend to climb rather than jump. Similar to fences, snow berms may create impasses to movement across a road, so roads used by people during winter should be plowed in such a way that berms are cut at regular intervals to facilitate crossing.

Suggested alterations to the 1980 Forest Travel Plan, provided in Table 10, should be considered for implementation as soon as possible. An effective road closure enforcement program should be funded and operated on a continuous basis.

Mining

Mining in the Cabinet Mountains is the most significant industrial threat to mountain goats and their habitat. The antiquated 1872 mining law provides that mineral resources and their extraction be accommodated over and above other resource values. Although opportunities are limited, in many instances conscientious management can prevent needless adverse impacts to wildlife habitat in areas proposed for or in the process of being developed.

At present, access must be allowed to valid claims, but the use of existing roads should be required rather than building new ones. In the event only one access route exists and occurs in a damaging location to goats, that road should be closed and reclaimed while an alternate more suitably placed road is constructed. During road construction, wildlife lick sites should be avoided. Minimum vegetation removal should be made along transportation or utility corridors, Pipelines, snow berms and fences should be constructed to allow goats and other wildlife to cross at regular, short intervals.

The use of helicopters should be encouraged to accomplish exploration activities but constraints must be imposed to accommodate seasonal needs of mountain goats. High level, straight line flights without deviations from a prescribed flight corridor are essential.

Workers should be bused to and from the mine site to reduce road kills and potential poaching, and shift changes should be scheduled to avoid morning and evening wildlife feeding periods. Workers should not be allowed to feed wildlife at the work site. Unnecessary noise should be kept to a minimum and drill rig engines should be muffled.

In portions of identified mountain goat range where mining activity is planned or occurring, other activities including logging, livestock grazing and recreational developments should be excluded.

Logging

Impacts to mountain goat habitat from logging have not, to the present, been significant in the Cabinet Mountains. However, the potential for logging to occur in mountain goat habitat may increase with changing national economic conditions and advancing technology.

Logging on or near mountain goat range should not occur in sensitive areas or during critical periods of the year. Logging activities should not occur within 1 mile of goat range during the June kidding period or November-December rutting period. All logging activities should be timed to occur during the season when the least number of goats are present and the operation should be completed as quickly as possible.

The minimum acreage necessary to buffer goat use areas from human activities is unknown, but information from the elk/logging studies (Lyon et al. 1979) indicates that the duration of activity is much more important than severity of the activity. Long-term disturbance at low levels imposes greater hardships upon the species than an intensive one of short duration. Timing of multiple operations is also important. It is best to schedule activities in adjacent drainages so they are not concurrent. This allows one drainage to provide security while the adjacent drainage is being disturbed. Disturbance should be limited to 1 year so that traditional use patterns are not disrupted for an extended period. If more than 1 year is needed, then each phase of the sale and clean-up should be timed to occur during seasons when fewest goats are present. The area of influence for one sale should be considered to include at least three drainages (one on each side of the affected drainage). In applying these recommendations derived from elk/logging research to goats, it is believed that timing and spatial configuration of logging activities are of even greater importance to goats since their flexibility is less. It is not known how quickly goats will return to a given area after disturbances have ceased, but in the East Kootenays of British Columbia, it has taken 7 to 10 years (D. Hebert, personal communication).

The size of cutting units should be kept to a minimum and should have irregular outline configurations. The units should not cross ridges which are important goat travel routes. All slash which would impede movement or prevent use of habitat should be removed. Ample vegetation along road sides should be left to block goat terrain from view of roads. Roads should be closed to public use during the harvest and permanently closed upon completion of the project. This action will prevent traffic use patterns from establishing. Security cover should be left for at least 100 feet on either side of a trail which is crossed by a logging road.

Timber sales, regardless of the method of harvest, should not be located on critical mountain goat seasonal ranges (Management Situation 1 areas). In Management Situation 2 areas, logging could occur only after ground reconnaissance of the site by a biologist resulted in guidelines to ensure that the site's future value as goat range is retained. In Management Situation 3 areas isolated patches of escape terrain should be protected by a buffer of vegetation; and ridges, whether they provide seasonal goat range or not should be avoided to protect their value as travel corridors. In Management Situation 3 areas no other constraints are imposed unless the site is adjacent to a Management Situation 1 or Management Situation 2 area and then timing and duration of activity should not coincide with goat use.

A complete picture of the relationship between past cutting and known mountain goat seasonal ranges and overall habitat in the Cabinet Mountains should be obtained through interpretation of current aerial photos and mapping of cutting units. Cutting units which are near or occur on mountain goat range should be studied to determine the treatment each has received, its date of cut, current vegetation status and road access. This information could be analyzed to determine how past timber harvest practices have helped or hindered mountain goats and provide guidelines to management of future timber sales near goat range.

Livestock Grazing

At present, little or no competition exists between mountain goats and livestock in the Cabinet Mountains. Additional grazing allotments should not be created in the Cabinets and allotments which do exist should not be expanded to allow more use by cattle. Sheep grazing should not be allowed in the Cabinet Mountains.

Recreation

Increased recreation in mountain goat habitat as a consequence of expanding human population becomes a significant factor influencing goats and use of their habitat. To avoid inadvertently increasing conflicts between man and mountain goats, attention should not be drawn to areas where goats are easily observed either in wilderness or nonwilderness areas. Heavily used recreation areas should be monitored to determine whether mountain goats are being adversely affected by human activity and, if so, measures should be implemented to reduce those effects. For example, heavily used hiking trails which threaten to interfere with

seasonal use patterns of goats should not be maintained. Special emphasis should be placed upon restricting snowmobile use where it occurs on or near goat habitat.

Implementing the suggested alterations to the 1980 Travel Plan outlined in Table 10 will help reduce unintentional harassment of mountain goats in the Cabinets. Not all areas designated for closure to snowmobiles currently support wintering goats, but all areas for which closures were suggested are known to have supported wintering goats prior to road placement. The recommendations are based on the concept of returning the necessary security to these wintering areas as a prerequisite to reestablishment of wintering animals. Access enforcement measures should be instituted and use of snowmobiles in areas other than designated routes should be punishable by a significant fine. Management recommendations to help alleviate intentional violators might include offering a reward leading to the arrest and prosecution of offenders. Snowmobiling clubs might be willing to participate in order to police their own ranks and enhance their reputation. This violation report-reward system is already in effect where gates are in place to control access. The system could be expanded to include ditch and hump barriers and areas of voluntary exclusion.

Recommendations to land managers where hunting of goats tends to be overly concentrated include: immediate permanent closure of new logging roads near mountain goat habitat, seasonal closures of existing roads, permanent closure of roads for which seasonal closures cannot be enforced, and seasonal trail closures or abandonment of trail maintenance.

In an effort to distribute hunters more uniformly, wildlife managers could divide hunting districts into smaller areas, preferably according to drainage groups encompassing individual herds. This may provide insight into areas experiencing poaching and overhunting. Prior to the hunting season, the wildlife manager could provide each permit holder with a packet of information about mountain goat characteristics and habits. Pointers on distinguishing males from females could be outlined and the hunter would be encouraged to harvest males. A brief explanation of mountain goat social structure would be in order to explain that harvesting female goats reduces survival of young and disrupts herd structure. The wildlife manager should also follow up on every hunting permit issued to obtain age, sex and location information from each harvested goat in order to assess the number of females being taken from that area and whether a certain area is receiving undue pressure.

Mountain Goat Transplants

In managing wildlife habitat, emphasis should be placed on maintaining habitat, not reintroducing wildlife after they are lost due to accommodation of other resource extraction activities. Transplanting of wildlife into formerly occupied range has little value unless the causes of decline are understood and remedied. Introducing mountain goats may not result in reestablishment of a herd. Although we can physically transplant mountain goats, we cannot transplant thousands of years of range use knowledge. A typical uninformed response to wildlife declines in a particular area is simply to transplant wildlife back into the area. It is far more realistic

to preserve existing mountain goat populations than to allow these populations to become decimated and then attempt reintroduction.

In cases where biologists determine reintroductions are justified, caution should be exercised in transplanting animals to ensure that they are free of disease or parasites which could infect native animals. Williams et al. (1978) discusses the occurrence of paratuberculosis in bighorn sheep and mountain goats from Mount Evans and Grant, Colorado where the disease had not been previously documented. They speculate that introduced mountain goats may have been the carriers. Important in any transplant endeavor is a careful study of the stock's native climate and terrain as compared to their planned destination. Efforts should be made to match terrain and climate as closely as possible to help minimize stressful adjustment. If native genetic strains are important to preserve, introducing animals would not be desirable.

Habitat Improvement

Whether fire suppression has affected mountain goat range is not known. If fire suppression has been a negative influence on goat range, we can assume that seeding and planting of vegetation would not completely alleviate the problem since slash and the need for soil nutrients would still remain. Slash piling to remove obstacles to movement and allow light penetration to the soil may, in some instances, be preferable to burning but the cost of such an operation would likely be prohibitive. Fertilization of areas of goat winter range could be attempted, but cost may not be justified. If fire could be properly controlled in this difficult terrain, it might be an all purpose remedy, accomplishing each of the foregoing: seeding, plant stimulation, nutrient release and slash removal. The problem of rejuvenating mountain goat winter range is complex since a fire in steep terrain is extremely difficult to control and since in some areas the fuels build-up is at or near the point that the entire vegetative complex may burn.

If a habitat improvement program for goat winter range is to be implemented, the prerequisite is comprehensive, long-range planning and monitoring of selected sites and the response. Most of the confirmed, probable and possible goat winter sites in the Cabinets are known. A long-term rotation plan over the next 30 years or more should be developed in which sites throughout the Cabinets (if they are in need of treatment) are burned and then monitored over several years. Information gathered in this way will suggest fire types and sizes which are best for different situations and the rate of vegetation response to the point where the site is usable by wintering goats. The entire acreage of a given area should not be burned at one time in order to promote partial use of the site by goats. This would require intensive fire management to keep the burn confined to a specified area of generally 30 to 100 acres. Two areas in adjacent drainages should not be treated within the same several year period. A fire ecologist and botanist could predict the rejuvenation period needed before the site is producing adequate forage to support wintering goats (shrubs of sufficient height and conifers providing snow intercept). Once the first site has revived, the second site could be treated. In a study of mountain goat range in the Cascade Mountains of Washington, Olmsted (1979) established that a minimum of 12 years was necessary, post-burn, before good shrub production was realized. In Montana

this time period would likely be longer. A greater ratio of probable and possible winter sites should be treated in relation to confirmed sites because we cannot afford to jeopardize known use areas. A coordinated effort among the four involved ranger districts would help maintain continuity in the burning program for the entire mountain range and thus avoid over management in one area. This conservative approach is essential when dealing with a species whose versatility is limited.

Before burning is attempted on confirmed winter ranges in the Cabinets, the Smith Mountain burn of 1979 should be carefully analyzed and monitored over the next several years at plot sites typical of elevations, aspects and slopes upon which goats might winter. The same analysis should be done in the Wiggletail drainage where a fire occurred in 1973. Goats are not known to winter on Smith Mountain or in the burned area of Wiggletail, but they do winter lower in the Wiggletail drainage. Information collected from burned areas on goat range over the last several decades would provide important management guidance in the future use of fire. In addition to monitoring the response of vegetation to burning, the mountain goat population of the area must also be monitored to quantify population trends.

Natural and prescribed burns should not be allowed on Management Situation 1 winter range until research information is available. Fires on Management Situation 2 winter range should be allowed only after careful research in other areas produces evidence that burns in such areas have not harmed habitat or have been beneficial to mountain goats. On Management Situation 2 winter range fires should be limited to a small area (30 to 100 acres) to prevent total exclusion of its use by goats.

If mountain goats are to receive management consideration in the fire management scheme, their range should be incorporated into big game range maps being used on the districts. Fire management plans have only been completed on the Troy Ranger District. This district encompasses over 9,800 acres of goat winter range (confirmed, probable and possible). These acreages were not included on the big game range maps because their location and extent were not known. It is recommended that this new information be incorporated into existing and future fire management plans.

Lyon et al. (1978) in a USDA General Technical Report regarding the effects of fire on fauna states: "We need to identify those animal species with narrow ecological tolerance, major socio-economic importance, and indicator values for groups of species. The research needed to complete this task is feasible and of high priority." The mountain goat fits these criteria.

Other Recommendations

Recent literature concerning mountain goat habitat use as well as the present investigation have indicated that timber is an integral part of mountain goat habitat. The value of timber on goat winter ranges should be closely examined for its importance in providing lichens and conifers for food, in reducing snow depths (snow intercept) and as thermal cover. On summer use sites the timber and shrub cover types should also be evaluated for their value as insulation from solar radiation.

Mountain goat trend counts should be conducted yearly in order to detect changes in habitat use and herd fluctuations. Irregular sex and age ratio surveys cannot be relied upon to gather this information. The same type of aircraft (preferably bubble type helicopter), pilot, flight path and observer should be used to standardize techniques. Late June or early July is the most productive survey period.

In implementing an effective habitat management plan, the cause rather than the symptom of poor range must be treated. To ensure that this is accomplished before, during and after, effects of habitat treatments should be analyzed. The following section provides a discussion of information necessary to monitor mountain goats and their habitat when human activities are occurring or forecast in an area.

Management Indicator Species - Future Monitoring Needs

On the Kootenai National Forest, the mountain goat should receive recognition at the Forest level as a management indicator species, not only for the Rocky Area habitat that the regional office has designated (USDA Forest Service, no date) but also for Krumholz and Alpine/Tundra which, on the Kootenai Forest, occur almost exclusively in the Cabinet Mountains. Four criteria have been recently outlined by the Northern Region of the Forest Service to select management indicator species. The mountain goat fits all four very well. They include: (1) species dependent upon habitats that are diminishing or are of limited acreage or habitats that will be significantly impacted, (2) highly specialized species or those dependent upon specific habitats, (3) resident (versus migratory) species, (4) species currently being monitored or capable of being monitored. Another selection factor involves species which are commonly hunted. Although mountain goat hunting in the Cabinet Mountains is currently under a permit system, the demand for permits far exceeds the supply since the goat is a nationally sought trophy animal.

In comparison to most of the other species listed on the regional management indicator species list, the mountain goat meets the established requirements more closely in that it is a year-long resident, while the listed birds migrate and the other mammal species are subterranean entities for at least 50 percent of the year. Monitoring of the Cabinet Mountains mountain goat population has occured for 1 full year with supporting data collected during portions of 2 additional years. During the present study, the current population level has been assessed, many seasonal use areas have been identified, initial food habits data have been collected and existing human conflict areas are known. With this base of information, the mountain goat is an excellent choice as a management indicator species.

Whether or not the mountain goat is listed by the Kootenai National Forest as an indicator species, monitoring of the population and the habitat is vital. The objective in monitoring is to determine the changes in mountain goat ecology as a result of development in order to reduce or avoid the impacts to goats. Continuous incoming information will allow more precise management prescriptions, whereas now with limited information, recommendations must be broad. Site specific information about the cause and effect of a development and how to alleviate these effects is necessary

to ensure viable populations of mountain goats. Monitoring mountain goats would involve data collection on (1) population dynamics including kid survival, yearling recruitment, cohort mortality, productivity, male/female components, interaction between herds, and (2) habitat utilization including seasonal use areas, movement patterns, alternate use areas (whether they exist), snow depth analysis, preferred forage seasonal availability, forage nutrition, seasonal food habits, thermo-regulation, and reaction to various disturbances.

For the animal shall not be measured by man.
In a world older and more complete than ours,
they move finished and complete, gifted with
extensions of the senses we have lost or never
attained, living by voices we shall never hear . . . .

-Henry Beston

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APPENDIX

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Appendix 1

Observation form and code sheet

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SPECIES
OBSERVER

DATE	TIME	LOCATION: DRAINAGE	SECTION	TOWNSHIP	RANGE	NUMBER: TOTAL	ADULT	SUBADULT	KID	UNCLASSIFIED	ACTIVITY	TIME OBS	SITE DESCRIPTION: DIST. ESCAPE	DIST. TIMBER	DIST. ROAD	TERRAIN TYPE	COVER TYPE	HABITAT TYPE	ELEVATION	ASPECT	WEATHER: TEMPERATURE	CLOUD COVER	WIND SPEED	PPT. TYPE	PPT. RATE	GROUND COND.	REMARKS

OBSERVATION CODE SHEET

DATE 6-1-79
TIME 18:30
DRAINAGE N. Fk. Bull R.
SECTION 26
TOWNSHIP 28
RANGE 32

TOTAL 9
ADULT M1 (preface each number
F2 entry with M, F, or U
U2 for sex of animal)
SUBAD U1
KID U2
UNCL U1

ACTIVITY
1 standing (walking)
2 bedded
3 feeding
4 running
5 drinking
6 dead
7 track
8 hair
9 pellet group

(up to 3 activity codes may be used eg: 123 = standing, bedded, feeding)

TIME OBSERVED in minutes

DISTANCE TO ESCAPE TERRAIN (see terrain type marked with * which indicate mountain goat escape terrain)
1 less than 10 yards
2 10 - 50
3 50 - 100
4 over 100

DISTANCE TO TIMBER
1 less than 10 yards
2 10 - 50 yards
3 50 - 100 yards
4 over 100 yards

DISTANCE TO ROAD (a road is defined as vehicle right-of-way which is passable at the time which the animal was observed)
1 less than 1/4 mi
2 1/4 to 1/2 mi
3 1/2 to 1 mi
4 over 1 mi

TERRAIN TYPE (see descriptions)
1 bluffs
2 cliffs
3 cirque basin
4 talus slope
5 broken
6 ridge
7 park
8 creek
9 sidehill

COVER TYPE
1 timber
2 shrub
3 grass/forb
4 rock/bare

HABITAT TYPE (see list of codes and names below)

ELEVATION in hundreds of feet eg: 37 = 3700 feet

ASPECT
1 N 6 SW
2 NE 7 W
3 E 8 NW
4 SE 9 flat
5 S

TEMPERATURE
1 -0F
2 0 - 32
3 32 - 40
4 40 - 60
5 60 - 80
6 over 80

CLOUD COVER
1 clear
2 partly cloudy
3 mostly cloudy
4 overcast

WIND SPEED (Beaufort Numbers)

Number	MPH	Indicators
0	less than 1	smoke rises vertically
1	1 to 3	wind direction felt by smoke drift
2	4 to 7	leaves rustle
3	8 to 12	leaves, small twigs in constant motion
4	13 to 18	raises dust and loose paper
5	19 to 24	small trees in leaf sway
6	25 to 31	large branches in motion
7	32 to 38	whole trees in motion
8	39 to 46	breaks twigs off trees
9	above 47	structural damage

PPT. TYPE
1 rain
2 hail or sleet
3 snow
0 none

PPT. RATE
0 none
1 light
2 moderate
3 heavy

GROUND CONDITION
1 dry
2 damp
3 wet, muddy
4 scattered snow
5 snow (less than 6")
6 snow (6 to 12")
7 snow (over 12")

HABITAT TYPES
210 PSME/AGSP
220 PSME/FEID
230 PSME/FESC
250 PSME/VACA
260 PSME/PHMA
280 PSME/VAGL
290 PSME/LIBO
310 PSME/SYAL
320 PSME/CARU
350 PSME/ARUV
420 PICEA/CLUN
520 ABGR/CLUN
510 ABGR/XETE
530 THPL/CLUN
570 TSHE/CLUN
620 ABLA/CLUN
670 ABLA/MEFE
690 ABLA/XETE
830 ABLA/LUHI
850 PIAL-ABLA
860 LALY-ABLA
(incomplete list)

REMARKS
over and understory vegetation description
important if habitat type unknown
any other pertinent information

Appendix 2. Determination of snow depth index.

Use of a snow depth index facilitated analysis of several points within the study area for their suitability as mountain goat winter range. Sites were selected from 1:24,000 topographic maps based on elevation, aspect and slope. The index at 4,000 feet for each site was calculated and used as a common comparison point. The following regression equation used during this procedure, was developed from a series of data points collected over the years from Baree Mountain during the Kootenai National Forest's snow loading project:

$$x = 2.0134 \times y + 22.821$$

where x = snow depth and y = water equivalence. In northwest Montana mean maximum snow depth approximates water equivalence (S. Johnson, hydrologist, personal communication). The hydrologists who developed the following procedure (Tim Tolle and Steve Johnson) caution that there is a tremendous amount of variability in snow depths on the rugged diverse areas which were selected for analysis. For this reason the results are treated as indicies rather than actual snow depths.

The attached figure shows the Kootenai National Forest divided into 19 precipitation zones. Each zone has an associated precipitation/runoff versus elevation curve. The study area encompasses three zones (11, 12, 17). The following procedure was used to compile the information presented in Table 7:

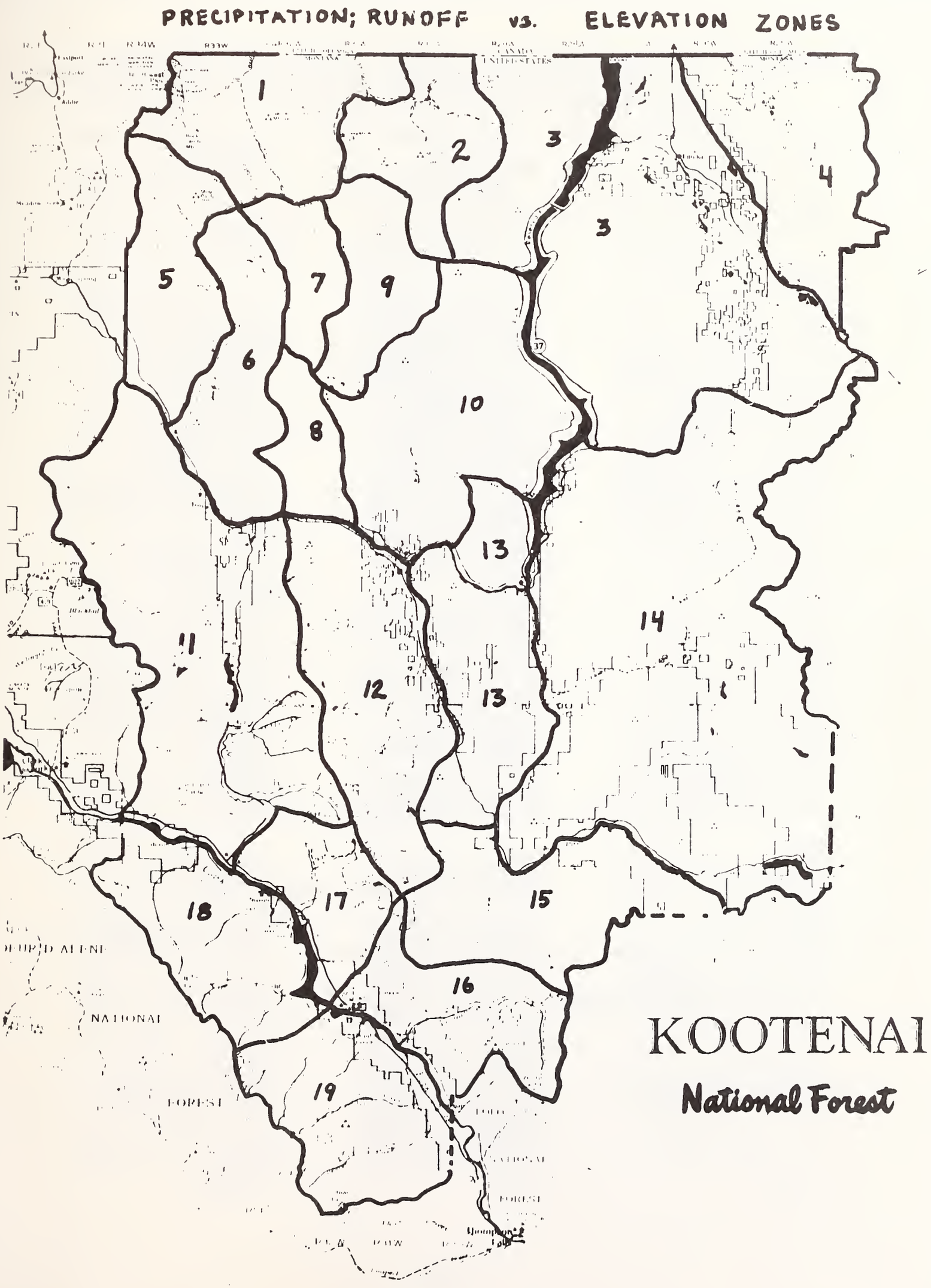
1. Site selection from 1:24,000 topographic maps. The elevational range of the area was determined as well as the general aspect and slope.

2. Mean annual precipitation for the elevational limits were taken from the proper zone curve.

3. The estimated water equivalence for the lower elevation, then for the upper elevation was applied to the regression equation: $y = \frac{x - 22.821}{2.0134}$.

4. The resulting figures were corrected for aspect and slope as follows: Aspect - for each 10 degrees variation from the east-west axis, 4/9 inch was subtracted for south and added for north. Slope - for each 10 degrees of mean slope, 2.3 inches were subtracted.

5. The corrected water equivalence figures were then reapplied to the equation to give the snow depth index: $x = 2.0134 \times y + 22.821$.


PRECIPITATION; RUNOFF vs. ELEVATION ZONES
1
2
3
4
3
5
7
9
6
8
10
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14
11
12
13
18
17
15
16
19
KOOTENAI
National Forest

Appendix 3. Seasonal forage use by mountain goats in the Swan Range as observed by Chadwick (1973) with emphasis upon species known to occur in the Cabinet Mountains.

Scientific Name[1/]	Common Name	Observed Monthly Use
TREES		
*Pseudotsuga menziesii** [2/]	Douglas-fir	Feb Dec
SHRUBS		
*Acer glabrum**	Rocky Mtn. maple	Mar Jun Jul Aug Sept
*Actea rubra**	western baneberry	Jun Aug Sep
*Amelanchier alnifolia**	western serviceberry	Mar May-Dec
Artemisia michauxiana	michaux sagebrush	Jun Aug Oct Nov
Berberis repens	Oregon grape	Nov Dec
*Juniperus communis**	common juniper	Feb Mar Dec
Lonicera utahensis	Utah honeysuckle	Jun Jul Aug
*Menziesia ferruginea**	rusty menziesia	Jun Jul Aug
*Pachistima myrsinites**	myrtle pachistima	Apr Jun Aug Sept Oct
*Philadelphus lewisii**	Lewis mockorange	May-Sep
Potentilla fruticosa	shrubby cinquefoil	Aug
Prunus sp.	cherry	Mar Jun-Oct
Ribes lacustre	swamp currant	Jun-Sept
Rosa spp.*	rose	Aug Sept
*Rubus idaeus**	red raspberry	Jul
*Rubus parviflorus**	western thimbleberry	Jul Aug Sept Dec
Salix spp. *	willow	Jul
*Sambucus racemosa**	scarlet elderberry	Aug
*Sorbus scopulina**	mountain ash	Jun Jul Aug Sept Dec
*Spiraea betulifolia**	white spirea	Jun-Dec
*Symphoricarpos albus**	common snowberry	Jun-Oct
*Taxus brevifolia**	Pacific yew	Nov Dec
*Vaccinium membranaceum**	big whortleberry	Jun-Oct
*Vaccinium scoparium**	grouse whortleberry	Jun Jul
FORBS		
*Achillea millefolium**	common yarrow	May-Sept
*Agastache urticifolia**	nettle-leaf giant hyssop	May-Aug
Allium cernuum	nodding onion	Apr-Sept
Angelica arguta	common angelica	May Jun Jul Sept
Antennaria parviflora	small-leaf pusseytoes	Jul
*Antennaria racemosa**	raceme pussytoes	Jun Jul
*Apocynum androsaemifolium**	spreading dogbane	Jul Oct
Arabis holboellii	Holboell rockcress	Jul
A. nuttallii	Nuttall rockcress	May-Aug
A. sparsifolia	fewleaf rockcress	May Jun
*Arenaria capillaris**	fescue sandwort	May Jun Jul Oct
*Arnica cordifolia**	heartleaf arnica	Jun Jul Aug
*Arnica latifolia**	broadleaf arnica	Jun Jul Aug
Aster foliaceus	leafy-bracht aster	Jun
A. laevis	smooth aster	Jul-Oct
A. sp.	aster	Jun-Sept

Appendix 3 continued.

Scientific Name	Common Name	Observed Monthly Use
*Aster engelmanni**	Engelmann aster	Jun-Sept
*Athyrium filix-femina**	common ladyfern	Jul Aug
*Balsamorhiza sagittata**	arrowleaf balsamroot	Jun Jul
*Calochortus apiculatus**	mariposa lily	May Jun Jul
*Campanula rotundifolia**	roundleaf harebell	July Aug
*Castilleja hispida**	Indian paintbrush	Jun-Sept
Circaea alpinum	alpine circaea	Aug
*Claytonia lanceolata**	lanceleaf springbeauty	May Jun Jul
Clematis columbiana	rock clematis	Jun
Cystopteris fragilis	bladder-fern	Jun
Delphinium bicolor	low larkspur	Feb-Jul Nov
Dodecatheon pauciflorum	southern shootingstar	May-Jul
*Epilobium angustifolium**	fireweed willow-herb	Jun Jul Aug
E. glandulosum	glandular willow-herb	Jun Jul
E. paniculatum	panicled willow-herb	Aug
Erigeron compositus	fernleaf fleabane	May Jun
*E. speciosus**	Oregon fleabane	Jul Aug Sept
Erigonum flavum	yellow eriogonum	Jul
E. ovalifolium	oval-leaf eriogonum	Jun Jul Oct Nov
*Erythronium grandiflorum**	glacier lily	May Jun
Fragaria vesca	woodland strawberry	Jun Jul
Gentiana calycosa	pleated gentian	Jul Aug
Geum triflorum	prairie smoke	May Jul
Habenaria sp.	bog-orchid	Jul
Haecklia jessicae	many-flowered stickseed	Jul Aug
Hedysarum occidentale	western sweetvetch	Jun-Aug
*Heracleum lanatum**	common cowparsnip	Jun Jul
*Heuchera cylindrica**	roundleaf alumroot	Feb-Dec
Hieracium albertinum	hawkweed	Jun Jul Sept
*Hydrophyllum capitatum**	ballhead waterleaf	May Jun
Lithophragma parviflora	smallflower woodlandstar	Jun Jul
Lomatium dissectum	lomatium	May-Jul
L. sandbergii	sandberg lomatium	Jul
L. triternatum	nineleaf lomatium	Jun
Lupinus sp.	lupine	Jul
Mertensia longiflora	small bluebell	May
Microseris nutans	nodding microseris	May
Mimulus lewisii	Lewis monkey-flower	Aug
Osmorhiza chilensis	mountain sweetroot	May-Jul
*Parnassia fimbriata**	Rocky Mountain parnassia	Jul Aug
*Pedicularis contorta**	coiled pedicularis	Jun-Sept
*P. racemosa**	sickletop lousewort	Jul
Penstemon albertinus	Alberta penstemon	Feb May-Jul Oct Nov
P. fruticosus	shrubby penstemon	Mar Jun Jul Sept-Dec
P. lyalli	Lyall penstemon	Jul Aug
Phacelia hastata	silverleaf phacelia	Jul
Potentilla glandulosa	gland cinquefoil	May-Jul

Appendix 3 continued.

Scientific Name	Common Name	Observed Monthly Use
Prunella vulgaris	common selfheal	Aug
Ranunculus inamoenus	graceful buttercup	Jul
Sanicula graveolens	Nevada sancile	Jun
*Saxifraga bronchialis**	yellowdot saxifrage	Feb Jun Jul
*S. integrifolia**	Columbian saxifrage	Jun
S. occidentalis	western saxifrage	May-Jul
*Sedum stenopetalum**	yellow stonecrop	May Jun
*Selaginella densa**	spikemoss selaginella	Feb Mar Apr
S. sp.	lesser club-moss	Feb
*Senecio integerrimus**	lambstongue groundsel	May Jun Jul
S. pseudaureus	golden groundsel	Jul
*S. triangularis**	arrowleaf groundsel	May Jul Aug Sept
Smilacina racemosa	feather solomon's seal	Jun-Aug
Streptopus amplixifolius	large twisted-stalk	Aug
Suksdorfia ranunculifolia	suksdorfia	Jun
*Taraxacum officinale**	common dandelion	May Jun Jul
*Thalictrum occidentale**	western meadowrue	Jun-Sept
*Valeriana sitchensis**	Sitka valeriana	Jun-Sept
*Veratrum viride**	skunk cabbage	Jun Aug
*Xerophyllum tenax**	common beargrass	Jun Jul Aug
GRASS AND GRASS-LIKE PLANTS		
*Agropyron spicatum**	bluebunch wheatgrass	Mar-Nov
Bromus carinatus	mountain brome	May-Oct
*Calamagrostis purpurascens**	purple reedgrass	Feb-May Jul-Dec
Carex spp*	sedge	Feb-Dec
*Deschampsia atropurpurea**	purple hairgass	Aug
Elymus glaucus	blue wildrye	June Sep Oct
*Festuca idahoensis**	Idaho fescue	Feb-Dec
Luzula glabrata	wood-rush	Jun Jul
*Luzula parviflora**	wood-rush	Aug
Poa sandbergii	sandberg bluegrass	Feb Apr-Dec
Unknown grass*		Feb Jun Jul Sep Dec
*Lichens**		Feb Mar Apr
Mosses*		Feb Mar Apr

1 Most species listed here are found throughout northwest Montana and most likely do occur on mountain goat range in the Cabinet Mountains.

2 *Plant species recorded at mountain goat use sites in the Cabinet Mountains.

Appendix 4. Plant species identified on the Cabinet Mountains mountain goat study area with emphasis upon those occurring on known use sites.

Scientific Name[1/]	Common Name
Trees	
Abies grandis	grand fir
*Abies lasiocarpa** [2/]	subalpine fir
*Larix lyallii**	alpine larch
Larix occidentalis	western larch
Picea engelmanni	Engelmann spruce
*Pinus albicaulis**	whitebark pine
Pinus contorta	lodgepole pine
Pinus monticola	western white pine
Pinus ponderosa	ponderosa pine
Pseudotsuga menziesii	Douglas fir
Thuja plicata	western redcedar
Tsuga heterophylla	western hemlock
*Tsuga mertensiana**	mountain hemlock
Shrubs	
Acer glabrum	Rocky Mountain maple
Actea rubra	western baneberry
*Alnus sinuata**	Sitka alder
*Amelanchier alnifolia**	western serviceberry
*Berberis repens**	Oregon grape
Cassiope mertensiana	western mountain heather
*Chimaphila umbellata**	common pipsissewa
Ceanothus sanguineus	redstem ceanothus
Ceanothus velutinus	snowbrush ceanothus
Cornus canadensis	bunchberry dogwood
Cornus stolonifera	red-osier dogwood
Holodiscus discolor	ocean spray
*Juniperus communis**	common juniper
Juniperus scopulorum	Rocky Mountain juniper
*Menziesia ferruginea**	rusty menziesia
*Pachistima myrsinites**	myrtle pachistima
*Philadelphus lewisii**	Lewis mockorange
*Phyllodoce empetriformis**	red mountainheath
Phyllodoce spp.*	mountainheath
*Potentilla fruticosa**	shrubby cinquefoil
Prunus virginiana	common chokecherry
Purshia tridentata	antelope bitterbrush
*Ribes hendersonii**	currant
Rosa spp.*	rose
Rubus idaeus	red raspberry
*Rubus parviflorus**	western thimbleberry
Salix spp.*	willow
Sambucus racemosa	scarlet elderberry
Shepherdia canadensis	Canadian buffaloberry
Sorbus scopulina	mountain ash

Appendix 4 continued.

Scientific Name	Common Name
Spiraea betulifolia	white spirea
*Spiraea densifolia**	mountain spirea
Spiraea douglasii	Douglas spirea
*Symphoricarpos albus**	common snowberry
Taxus brevifolia	Pacific yew
*Vaccinium globulare**	blue huckleberry
Vaccinium membranaceum	big whortleberry
*Vaccinium scoparium**	grouse whortleberry
Unidentified shrub	
Forbs	
Achillea millefolium	common yarrow
Agastache urticifolia	nettle-leaf giant hyssop
Anemone multifida	ball anemone
*Antennaria microphylla**	pussytoes
*Antennaria neglecta**	field pussytoes
*Antennaria racemosa**	raceme pussytoes
Antennaria rosea	rose pussytoes
Antennaria spp.	pussytoes
Apocynum androsaemifolium	spreading dogbane
*Aquilegia flavescens**	yellow columbine
Aralia nudicaulis	wild sarsaparilla
*Arenaria capillaris**	fescue sandwort
*Arnica cordifolia**	heartleaf arnica
*Arnica latifolia**	broadleaf arnica
Arnica lonchophylla	arnica
Arnica mollis	hairy arnica
Arnica spp.	arnica
Aster engelmanni *	Engelmann aster
Athyrium filix-femina	common ladyfern
Balsamorhiza sagittata	arrowleaf balsamroot
Calochortus apiculatus	mariposa lily
*Campanula rotundifolia**	roundleaf harebell
Campanula sp.	bellflower
*Castilleja miniata**	scarlet Indian paintbrush
Castilleja hispida	Indian paintbrush
Cerastium arvense	starry cerastium
Claytonia lanceolata	lanceleaf springbeauty
Clintonia uniflora	queencup beadlily
Collinsia sp.*	collinsia
Compositae sp.*	composite
*Draba oreibata**	draba
*Epilobium alpinum**	alpine willow-herb
*Epilobium angustifolium**	fireweed willow-herb
Erigeron caespitosus	tufted fleabane
*Erigeron humilus**	fleabane
Erigeron peregrinus	peregrine fleabane
Erigeron simplex	oneflower fleabane
Erigeron speciosus	Oregon fleabane

Appendix 4 continued.

Scientific Name	Common Name
Eriogonum sphaerocephalum	wild-buckwheat
*Eriogonum umbellatum**	sulfur eriogonum
Eriogonum spp.	wild-buckwheat
*Erythronium grandiflorum**	glacier lily
Equisetum arvense	field horsetail
Galium triflorum	sweet-scented bedstraw
*Haplopappus integrifolius**	goldenweed
*Heracleum lanatum**	common cowparsnip
Heuchera cylindrica	roundleaf alumroot
Heuchera grossulariifolia	alumroot
Heuchera parvifolia	littleleaf alumroot
Heuchera sp.*	alumroot
Hieracium cynoglossoides	houndstongue hawkweed
*Hieracium gracile**	slender hawkweed
Hieracium sp.	hawkweed
Hydrophyllum capitatum	ballhead waterleaf
*Hypericum formosum**	southwestern St. John's-wort
*Ligusticum verticillatum**	ligusticum
Lomatium spp.	biscuitroot
*Lynchnis drummondii**	drummond cockle
Mertensia sp.	bluebells
*Mitella brewerii**	miterwort
*Mitella stauropetala**	starry miterwort
Mitella sp.*	miterwort
*Oxyria digyna**	alpine mountainsorrel
*Parnassia fimbriata**	Rocky Mountain parnassia
Pedicularis bracteosa	bracted lousewort
*Pedicularis contorta**	coiled pedicularis
Pedicularis racemosa	sickletop lousewort
Pedicularis sp.*	lousewort
Penstemon attenuatus	sulfur penstemon
Penstemon ellipticus	rockvine penstemon
Penstemon flavescens	penstemon
Penstemon fruticosus	shrubby penstemon
Penstemon lyallii	Lyall penstemon
*Penstemon montanus**	cordroot penstemon
*Potentilla arguta**	silverweed cinquefoil
*Ranunculus eschscholtzii**	largeflower buttercup
Ranunculus sp.	buttercup
Romanzoffia sitchensis	sitka romanoffia
*Saxifraga bronchialis**	yellowdot saxifrage
*Saxifraga ferruginea**	rusty saxifrage
*Saxifraga integrifolia**	Columbian saxifrage
*Saxifraga mertensiana**	Mertens saxifrage
*Saxifraga rhomboidea**	diamondleaf saxifrage
Saxifraga sp.*	saxifrage
*Sedum lanceolata**	lance-leaf stonecrop
*Sedum roseum**	rose stonecrop
*Sedum stenopetalum**	yellow stonecrop

Appendix 4 continued.

Scientific Name	Common Name
*Selaginella densa**	spikemoss selaginella
*Senecio integerrimus**	lambstongue groundsel
*Senecio triangularis**	arrowleaf groundsel
*Taraxacum officinale**	common dandelion
*Thalictrum occidentale**	western meadowrue
*Thelypodium sagittatum**	arrow thelypodium
*Valeriana sitchensis**	Sitka valeriana
Valeriana sp.*	valerian
*Veratrum viride**	skunk cabbage
*Xerophyllum tenax**	common beargrass
Unknown forb*	
Ferns	
*Cheilanthes gracillima**	lip-fern
*Woodwardia fimbriata**	chain-fern
Grasses	
*Agropyron dasystachyum**	thickspike wheatgrass
*Agropyron spicatum**	bluebunch wheatgrass
Bromus sp.*	brome grass
*Calamagrostis canadensis**	bluejoint reedgrass
*Calamagrotis purpurascens**	purple reedgrass
*Calamagrostis rubescens**	pine reedgrass
*Carex geyeri**	elk sedge
Carex spp.*	
*Deschampsia atropurpurea**	purple hairgrass
Deschampsia elongata	slender hairgrass
*Festuca idahoensis**	Idaho fescue
*Festuca viridula**	green fescue
Juncus sp.*	rush
*Luzula hitchcockii**	wood-rush
*Luzula parviflora**	wood-rush
*Phleum alpinum**	alpine timothy
*Poa alpina**	alpine bluegrass
*Poa gracillima**	slender bluegrass
*Poa incurva**	bluegrass
Poa sp.*	bluegrass
*Trisetum spicatum**	spike trisetum
Unknown grass*	
Lichens*	
Mosses*	
Mushrooms	

Appendix 4 continued.

1/ Scientific names taken from Hitchcock and Cronquist (1973). Common names taken from Booth and Wright (1959), Booth (1950), and Scott and Wasser (1980).

2/ *Plants noted at mountain goat use sample sites.

Appendix 5. Existing trails on the study area.

EAST CABINET MOUNTAINS

Libby Ranger District

Trail No.	Location	Type of Management
649	Scenery Mountain	maintained; closed to motorized vehicles
141	Cedar Creek	maintained; closed to motorized vehicles
140	Parmenter Creek	maintained; closed to motorized vehicles
---	Parmenter-Flower Cr.	maintained; closed to motorized vehicles
137	Flower Creek	maintained; closed to motorized vehicles
317	S. Fk. Parmenter Cr.	maintained; in wilderness
360	Cabinet Divide	maintained; in wilderness
---	Hanging Valley	not maintained; in wilderness
136	Granite Creek	maintained; closed to motorized vehicles
---	Klatawa Lake	brushed out by hunters; Forest Service will not maintain; in wilderness
132	Leigh Lake	maintained; closed to motorized vehicles
---	Libby Lakes	not maintained
116	Twin Peaks	maintained; closed to motorized vehicles
302	Ozette Lake	not maintained
658	Bramlett Creek	maintained; closed to motorized vehicles
115	Fourth of July Creek	maintained; closed to motorized vehicles
656	Geiger Lakes	maintained; closed to motorized vehicles
114	Geiger Lakes-Iron Meadows	maintained
113	Trail Creek	maintained
531	Bear Lakes	maintained; closed to motorized vehicles
63	Bear Lakes-Cabinet Divide	maintained; closed to motorized vehicles
489	Baree Mountain	maintained; closed to motorized vehicles

Cabinet Ranger District

912	Swamp Creek	maintained; closed to motorized vehicles
360	Carney Peak-Baree Mtn.	maintained; in wilderness
921	Goat Ridge	maintained; closed to motorized vehicles
924	Goat Peak	maintained; closed to motorized vehicles
932	Engle Peak	maintained
926	Engle Lakes	management unknown; in wilderness
993	Moran Basin	maintained; partially in wilderness
646	E. Fk. Bull River-St. Paul Lake	maintained; in wilderness
966	Devil's Club-Dad Peak	not maintained; in wilderness
987	Poplar Point-Dad Peak	not maintained; partially in wilderness
978	M. Fk. Bull River	maintained; partially in wilderness
978	M. Fk. Bull River-Ibex Creek	not maintained; in wilderness
980	M. Fk. Bull River-Lentz Peak	not maintained; in wilderness
972	N. Fk. Bull River	maintained; partially in wilderness

Appendix 5 continued. Existing trails on the study area.

EAST CABINET MOUNTAINS

Troy Ranger District

Trail No.	Location	Type of Management
326	Crowell Creek	maintained
320	Taylor Peak	maintained
320	Taylor Peak-Upper Cedar L.	proposed for reconstruction
319	Shannon L.-Wm. Grambauer Mtn.	maintained; partially in wilderness
319	Wm. Grambauer-Scenery Mtn.	maintained; in wilderness
320	Williams Creek	maintained

WEST CABINET MOUNTAINS

Troy Ranger District

427	N. Fk. Callahan Cr. Rd.	open to winter use-snowmobiling and skiing
407	Roberts Mountain Road	periodically maintained
---	N. Callahan-W. Cabinet Divide	reconstruction planned
410	Caribou Creek	periodically maintained
54	S. Fk. Callahan Cr.	periodically maintained
---	S. Fk. Callahan-Goat Mtn.	proposed trail
148	Goat Mtn.-Iron Creek	periodically maintained
---	Keeler Creek-Lime Butte	periodically maintained
473	Keeler Cr. Dr.-Rattle Mtn.	open to winter use-snowmobiling and skiing
---	Twilight-Club-Pooch-Club	proposed trail
---	Twilight Cr.-N. Fk. Ross Creek Divide	proposed trail
324	Cub Creek-Spar Peak	periodically maintained
143	Spar Creek	periodically maintained
398	Ross Cr. Cedars Rd.-Bad Medicine Camp	open to winter use-snowmobiling and skiing
142	Ross Creek-M. Fk. Ross Cr.	periodically maintained
321	S. Fk. Ross Creek	periodically maintained

Cabinet Ranger District

1019	Hamilton Gulch	periodically maintained
1016	Star Gulch	periodically maintained
1035	Napoleon Gulch	periodically maintained
1036	Pellick Ridge	periodically maintained
---	Blacktail Creek	periodically maintained

KANIKSU NATIONAL FOREST
(Administered by KNF)

---	Cabinet Gorge-Mosquito	management unknown
---	Clark Fk.-Gold Cr.	"
---	Mosquito Cr.-Sugarloaf	"
65	Mosquito-Scotchman Peak	"
35	Goat Mountain	"

Appendix 5 continued. Existing trails on the study area.

KANIKSU NATIONAL FOREST
(Administered by KNF)

Trail No.	Location	Type of Management
556	Regal Creek	management unknown
132	Morris Creek	"
61	Savage Creek	"
563	E. Fork Peak	"
60	Rattle Creek-Lightening Pk.	"
134	Lightening Peak	"
1559	Mud Creek	"
---	Rattle Cr.-Moose Creek	"
---	Moose Lake-Lake Estelle	"
---	Deer Cr.-Blacktail Lake	"
---	Deer Cr.-Moose Creek	"
---	Gem Lake	"
---	Lightening Cr.-S. Fk. Callahan Cr.	"
152	Mount Pend Oreille	"

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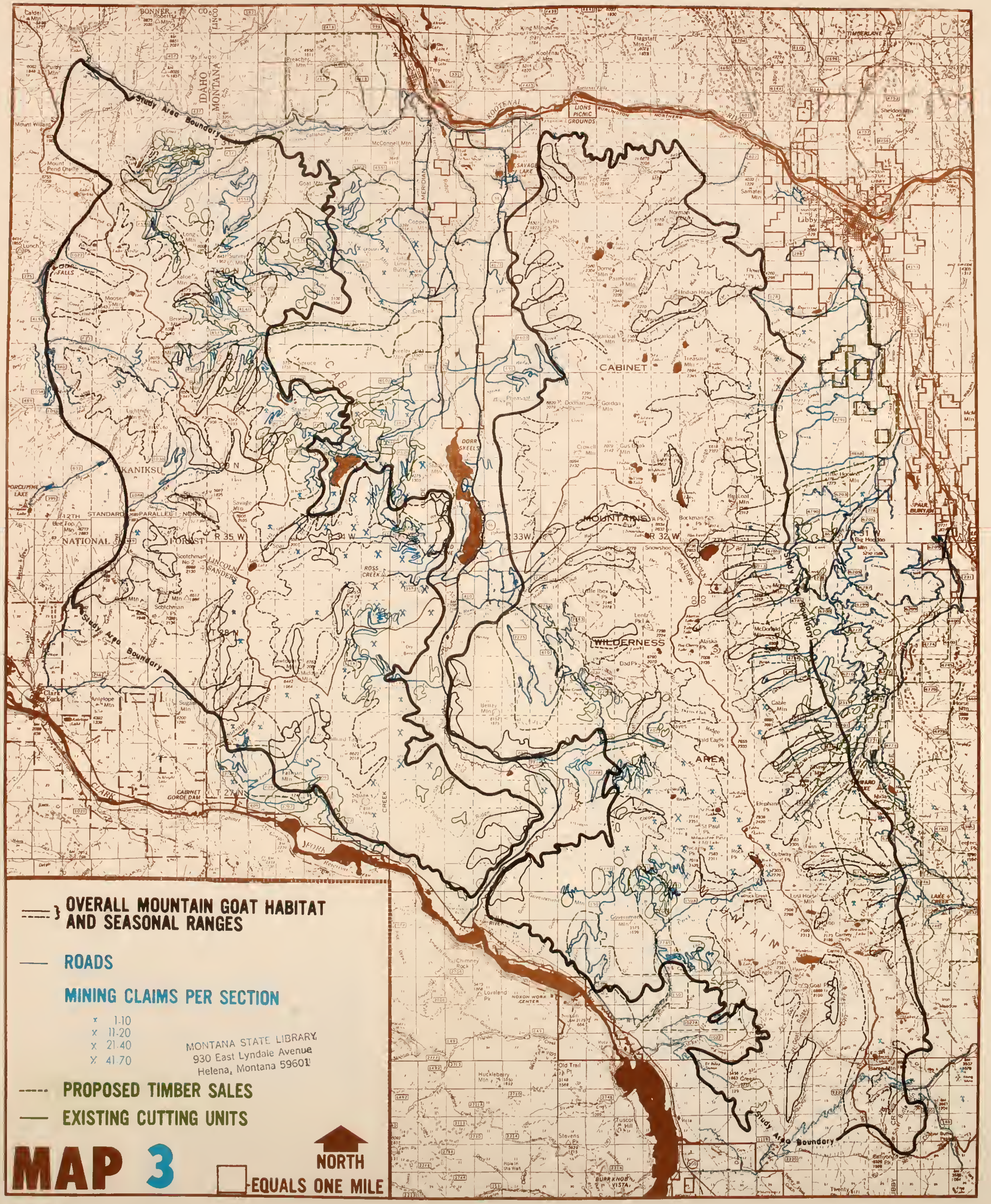
MAP ERRATA

Correction for Map 3:

Four cutting units (solid green line) on Pillick Ridge (NW of mouth of Bull River) are nonexistent.



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OVERALL MOUNTAIN GOAT HABITAT AND SEASONAL RANGES

FIRE OCCURRENCE. NUMBERS INDICATE YEAR IN WHICH FIRE BURNED. ALL FIRES OCCURRED IN 1900's. CIRCLE INDICATES SPOT LOCATION, OUTLINED AREAS SHOW BOUNDARIES OF LARGER FIRES.

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MAP 4

NORTH

EQUALS ONE MILE

MOUNTAIN GOAT SEASONAL RANGES AND OVERALL HABITAT IN THE CABINET MOUNTAINS

OVERALL HABITAT, STUDY AREA BOUNDARY
CONFIRMED WINTER RANGE
PROBABLE WINTER RANGE
POSSIBLE WINTER RANGE
SUMMER-TRANSITIONAL RANGE
W WINTER
ST SUMMER-TRANSITIONAL
1 MANAGEMENT SITUATION 1
2 MANAGEMENT SITUATION 2
3 MANAGEMENT SITUATION 3

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MAP 2

ONE INCH = ONE MILE

NORTH